



TAMPEREEN TEKNILLINEN YLIOPISTO  
TAMPERE UNIVERSITY OF TECHNOLOGY

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**Developing Management Accounting for Long-Term Decision-Making**  
Empirical Examinations from the Customer and Supplier Perspectives



Julkaisu 1592 • Publication 1592

Tampere 2018

Tampereen teknillinen yliopisto. Julkaisu 1592  
Tampere University of Technology. Publication 1592

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## **Developing Management Accounting for Long-Term Decision-Making**

Empirical Examinations from the Customer and Supplier Perspectives

Thesis for the degree of Doctor of Science in Technology to be presented with due permission for public examination and criticism in Festia Building, Auditorium Pieni Sali 1, at Tampere University of Technology, on the 16<sup>th</sup> of November 2018, at 12 noon.

Tampereen teknillinen yliopisto - Tampere University of Technology  
Tampere 2018

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ISBN 978-952-15-4249-7 (printed)  
ISBN 978-952-15-4258-9 (PDF)  
ISSN 1459-2045

## ABSTRACT

**Lindholm Anni, 2018:** “Developing Management Accounting for Long-Term Decision-Making: Empirical Examinations from the Customer and Supplier Perspectives”

**Keywords:** Management accounting, decision-making, long-term costs, long-term profits

The aim of this thesis is to examine management accounting (MA) development that can facilitate investment decision-making in customer organizations and business development in supplier organizations through the following research questions: 1) How can the customer’s investment decision-making be supported with MA information? 2) How can the supplier’s business development be supported with MA information? 3) What kinds of characteristics are desired for MA development to support long-term decision-making?

The main contribution of this thesis is in showing that MA can increase the likelihood of good decisions simply by structuring the long-term decision effects in monetary terms and integrating knowledge into meaningful insights. Secondly, the thesis contributes to the existing understanding about using value-for money (VfM) and life-cycle costing (LCC) for decision-making in public and private organizations. Organizations need MA practices and tools that can help rationalize and guide investment decision-making in which subjective factors play a significant role. Thirdly, this thesis contributes to the servitization literature by identifying needs for MA development in the context of manufacturing companies moving toward more service-based business models. MA information about existing, rather traditional service business could serve the purpose of partially understanding customer behavior and thus support new service business development. Overall, this thesis suggests that there is a need to achieve a certain balance between accuracy and simplicity in MA development.

This thesis is a collection of four articles that are based on in-depth qualitative case studies. The first article focuses on the VfM considerations in the Finnish waste-management context. It presents a path to overcome the conceptual VfM challenges in public procurement with the help of quality requirements and methods such as LCC. The second article concerns LCC model development for defense material in Finnish Defence Forces (FDF) and illustrates the possibilities and challenges related to practicing LCC in an uncertain environment.

The last two articles focus on MA development in the context of machinery-manufacturers’ global service business development. The third article discusses how the service business potential can be understood through MA and presents how MA enables the consolidation of scattered financial and non-financial data to better support decision-making. The fourth article illustrates how machinery manufacturers can segment their spare part business customers with the RFM-analysis (recency of purchase, frequency of purchase, and monetary value of purchase) typically applied in consumer business. The article shows how certain methods outside the traditional MA practices can provide decision support for business development.





# TIIVISTELMÄ

**Lindholm Anni, 2018:** “Johdon laskentatoimen kehittäminen pitkän aikavälin päätöksenteon tueksi: Empiirisiä tarkasteluja asiakkaan ja toimittajan näkökulmasta”

**Avainsanat:** Johdon laskentatoimi, päätöksenteko, pitkän aikavälin kustannukset, pitkän aikavälin tuotot

Tämän väitöskirjan tavoitteena on tarkastella kuinka johdon laskentatoimi voi tukea investointipäätöksentekoa asiakasorganisaatioissa ja liiketoiminnan kehitystä toimittajaorganisaatioissa seuraavien tutkimuskysymysten kautta: 1) Kuinka tukea asiakkaan investointipäätöksentekoa laskentatiedon avulla? 2) Kuinka tukea toimittajan liiketoiminnan kehitystä laskentatiedon avulla? 3) Millaisia ominaisuuksia tarvitaan pitkän aikavälin päätöksentekoa tukevan laskentatoimen kehittämiseen?

Tutkimuksen pääkontribuutiona on osoittaa, että laskentatoimen avulla on mahdollista parantaa päätöksentekoa jo yksinkertaisesti jäsentämällä päätöksenteon pitkän aikavälin taloudellisia vaikutuksia ja integroimalla tietoa mielekkääseen muotoon. Toisekseen tutkimus edistää tämän hetkistä ymmärrystä siitä, kuinka parhaan hinta-laatusuhteen arviointi ja elinkaarilaskenta voivat tukea päätöksentekoa sekä julkisten että yksityisten hankintojen yhteydessä. Organisaatioissa on tarvetta käytännöille ja työkaluille, joiden avulla voi perustella ja ohjata investointipäätöksentekoa, jossa subjektiivisilla tekijöillä on usein merkittävä vaikutus. Lisäksi tutkimus tarjoaa kontribuution palvelukirjallisuuteen tarkastelemalla johdon laskentatoimen ja palveluliiketoiminnan kehittämisen välistä yhteyttä. Laskentatoimen avulla tuotettu tieto perinteisistä palveluista saattaa auttaa ymmärtämään asiakkaiden käyttäytymistä ja sitä kautta tukea uudenlaisen palveluliiketoiminnan kehittämistä. Kaiken kaikkiaan tämä tutkimus osoittaa, että sopivan tasapainon löytäminen tarkkuuden ja yksinkertaisuuden välillä on tärkeää kehitettäessä uusia laskentatoimen menetelmiä ja tapoja.

Tämä väitöskirja perustuu neljään artikkeliin, jotka pohjautuvat laadullisiin tapaustutkimuksiin. Ensimmäinen artikkeli keskittyy parhaan hinta-laatusuhteen arvioimiseen suomalaisen jätehuollon toimialalla ja esittää keinoja julkisiin hankintoihin liittyvien käsitteellisten haasteiden selättämiseen laadullisten vaatimusten ja menetelmien, kuten elinkaarilaskennan avulla. Toinen artikkeli käsittelee elinkaarilaskentamallin kehittämistä puolustusmateriaalille Suomen Puolustusvoimissa ja kuvaa mahdollisuuksia sekä haasteita, joita liittyy elinkaarilaskennan toteuttamiseen epävarmassa ympäristössä.

Kaksi viimeisintä artikkelia tarkastelee johdon laskentatoimen kehitystä laitevalmistajien globaaliin palveluliiketoimintaan liittyen. Kolmas artikkeli käsittelee palveluiden liiketoimintapotentiaalin tunnistamista laskentatoimen keinoin ja näyttää, miten laskentatoimen avulla on mahdollista koota yhteen hajanaista taloudellista ja ei-taloudellista tietoa päätöksenteon tueksi. Neljäs artikkeli käsittelee laitevalmistajien mahdollisuuksia segmentoida varaosaliiketoiminnan asiakkaita tyypillisesti kuluttajaliiketoiminnassa käytetyn RFM-analyysin (viimeisin osto, ostotiheys ja oston rahallinen arvo) avulla. Artikkeli osoittaa, miten perinteisten laskentatoimen käytäntöjen ulkopuolelta voi löytää liiketoiminnan kehittämistä tukevia menetelmiä.



## ACKNOWLEDGEMENTS

The story behind this thesis began many years ago and involved several people whom I wish to thank. First, I want to thank Associate Professor Teemu Laine for supervising my thesis. The guidance and support from Teemu made it possible for this thesis to be completed. My grateful acknowledgements go to the pre-examiners of this thesis: Professor Fredrik Nordin and Associate Professor Mario Rapaccini. I also acknowledge Professor Saku Mäkinen's feedback on the manuscript.

This thesis is based on several research projects. Thus, I thank the representatives of the organizations who took part in the projects for providing access to the data and for their valuable comments during the research process. I acknowledge the participating companies, Business Finland, DIMECC (Digital, Internet, Materials & Engineering Co-Creation), and MATINE (Maanpuolustuksen tieteellinen neuvottelukunta) for providing funding for the projects. In addition, I am thankful to The Foundation for Economic Education for the research grant to support this thesis.

Many thanks go to all my previous colleagues at the Cost Management Center for a pleasant working atmosphere and collaboration. Special thanks go to Tuomas Korhonen, Kati Stormi, Natalia Saukkonen, and Jari Paranko. I am thankful to Tuomas's co-operation in the research projects and when writing the articles. Kati's contribution to one of the articles is gratefully acknowledged. The discussions with Natalia have provided me with help and insights. I also want to thank Jari for providing me with the opportunity to start my career in research about fifteen years ago.

I owe my warmest thanks to my family and friends. First, I appreciate all the trust and encouragement from my parents, Anne and Eerik. I am very grateful to my siblings Outi, Anssi, and Aleks, and their families for their help and having nice moments together. The friendship with Anna-Kaisa is also acknowledged. Especially, I wish to express my gratitude to Petri for his support every step of the way. I am so happy to have you in my life.

Finally, my greatest thanks go to my lovely children Oliver, Kasimir, and Vivian. You bring me so much happiness and joy!

Hämeenlinna, 14.10.2018

Anni Lindholm



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## LIST OF ORIGINAL ARTICLES

- I** Lindholm, A., Korhonen, T., Laine, T. & Suomala, P., Engaging economic facts and valuations underlying VfM in public procurement, *Public Money & Management* (accepted for publication).
- II** Lindholm, A. & Suomala, P. (2007), Learning by costing: Sharpening cost image through life cycle costing? *International Journal of Productivity and Performance Management*, Vol. 56, No. 8, pp. 651-672.
- III** Lindholm, A., Laine, T. & Suomala, P. (2017), The potential of management accounting and control in global operations: Profitability-driven service business development, *Journal of Service Theory and Practice*, Vol. 27, No. 2, pp. 496-514.
- IV** Stormi, K., Lindholm, A., Korhonen, T. & Laine, T. (2017), RFM customer analysis for service business development: An interventionist case study of two machinery manufacturers, *Workshop & special issue for Journal of Management and Governance*, June 29-30, Pisa, Italy.

The author made a significant contribution to the first original article. In addition to the data-gathering and analysis, the author was responsible for writing the article under the guidance of the co-authors. Regarding the second original article, the data-gathering and the writing process were done in collaboration with another author. More particularly, the author was responsible for writing the majority of the first version of the article and another author improved the article throughout the review process. In the third original article, the author played a key role in data gathering and in the writing process. The co-authors' role in article III related mainly to the overall commenting and reviewing of the article. Article IV is based on two case studies in which the author was a key person in one of the two case studies. Thus, the author contributed to the empirical findings and conclusions concerning one of the case companies. In addition, the author was involved in writing the literature review of the article.

# 1 INTRODUCTION

## 1.1 Background

Management accounting (MA) means producing financial information for managerial-purpose use and it can support long-term decision-making in several ways. The strength of MA is in its ability to frame the decision situation and to create a common language with which people can communicate (Hall, 2010; Wouters & Verdaasdonk, 2002). Even though cognitive biases and politics may hinder rational decision-making (Quattrone, 2016), MA information can enhance the effectiveness and adaptiveness in decision situations by providing a common base for judgements. Decision-making related to investments and business development often have far-reaching economic implications including much complexity and uncertainty (Carr et al., 2010; Alkaraan & Northcott, 2006). Despite the challenging conditions, MA enables an outline to be formed of the decision effects and the creation of meaningful insights for decision support.

Even though a product's life-cycle costs exceed the purchase price in many cases, knowledge about the long-term cost structure of investments may not exist in many companies (Lindholm & Suomala, 2005). Life cycle costing (LCC) is an approach focusing on total costs occurring throughout a product life-cycle (Woodward, 1997). Especially in the planning phase, it could be extremely important for customers to be able to consider the long-term cost implications of investment alternatives because the life-cycle costs of different technologies may vary significantly (Ally & Pryor, 2016; Teerioja et al., 2012). In public procurement, there has been a shift toward life-cycle thinking, which means that procurers should seek products and services that offer the best long-term price–quality ratio with the help of MA methods such LCC.

Value for Money (VfM) refers to purchasing of products and services that offer the best quality with the lowest possible price (Glendinning, 1988). In the legal context, VfM means awarding a public contract to the most economically advantageous tender (MEAT). In practice, this means using LCC or a scoring formula that assigns numbers to different monetary and non-monetary elements of an offer (Bergman & Lundberg, 2013). In fact, numerous approaches to support long-term decision-making have been presented in the literature but the practitioners may not be able to apply the existing models with reasonable work (Bergman & Lundberg, 2013; Hochschorner, 2011; Korpi & Ala-Risku, 2008).

From the supplier's perspective, MA can provide a wide range of support for business development decisions. Servitization refers to the shift from selling products to selling



the integration of products and services that deliver value for the customer (Baines et al., 2009). However, traditional MA practices may not provide sufficient support for decision-making when manufacturing companies try to exploit their service business opportunities (Baines et al., 2017). Thus, service business development drives changes in producing MA information (Cinquini et al., 2015; Laine et al., 2012). First, companies should be able to examine the overall profitability implications of providing combinations of products and services. This may be challenging if the lines of responsibilities and MA practices are divided traditionally according to product and service categories.

Regarding servitization, there is a need to get a broad view of the business environment and customers with the help of MA and other information. For example, companies can segment their customers with the RFM-analysis that examines how recently a customer has purchased (recency), how often they purchase (frequency), and how much the customer spends (monetary value of purchase) (Verhoef et al., 2003). In addition, possibilities of utilizing the installed base information in business development have been noted (Wagner & Lindemann, 2008). Overall, the potential of MA in companies' competitive positioning and in customer-profitability management has been highlighted in the literature (Holm et al., 2016).

To summarize, decision-making regarding both investments and service business development requires a comprehensive view of the costs and profits that will be incurred in the future. As MA can help to shape the problematic issues and the criteria that are used in selecting a credible solution (Burchell et al., 1980), it plays a key role in supporting long-term decision-making. However, traditional MA practices may be challenged because there may be a need to combine information from different data sources and from outside the boundaries of MA. Indeed, useful MA information may become available outside the financial department's processes or outside other traditional MA activities for planning and control. In practice, for example, the maintenance plan created by the service department could be needed to estimate product's life cycle costs or service business profitability. In addition, MA information (including non-quantifiable outcomes and the elements of uncertainty) questions the rationality of decision-making. Clearly, there is a need for MA development that helps the likelihood of good decisions by encouraging comprehensive thinking and by presenting information in a structured form (see e.g., Butler & Ghosh, 2015).

## **1.2 Motivation behind the research**

### **1.2.1 The need for research on MA supporting investment decision-making**

Investments are typical examples of decisions related to fulfilling long-term business objectives. MA can help to frame and assess the decision effects in different situations.

This thesis examines how MA can support VfM considerations in public procurement and estimation of product's life-cycle costs. Especially public authorities must be able to objectivize their assessments and rationalize the investment decisions, while private customers can, in principle, make their choices more intuitively. Thus, actors in the public sector probably have different needs regarding MA development in relation to private-sector actors.

In public procurement, there has been a shift toward life-cycle thinking and away from a reliance only based on the purchase price (e.g., Dimitri, 2013). Thus, public authorities must seek to objectivize their assessment by relying on the idea of VfM and more precisely, use MEAT when awarding contracts. However, embedding VfM considerations into the procurement process is not simple for several reasons. First, the current literature addresses the ambiguity of the VfM concept and the practical challenges arising from that (McKevitt & Davis, 2016; Prowle et al., 2016). Second, it has been widely recognized in the literature that the set-up for the VfM consideration may be complicated because of the non-quantifiable and subjective criteria usually included in MEAT (Lahdenperä, 2013; Falagario et al., 2012). In turn, there is substantial research on tender evaluation models (Kiiver & Kodym, 2015; Bergman & Lundberg, 2013; Dimitri, 2013; Mateus et al., 2010) and on the critical perspectives relating to the methodological approaches relevant to carrying out VfM analysis (Khadaroo, 2008; Grimsey & Lewis, 2005). In all, there is no adequate knowledge on how public authorities can pursue VfM by not only relying on MEAT, but also by considering the appropriate quality and life-cycle aspects throughout the procurement process.

LCC is a timely issue, especially in the public-procurement context, since the latest EU directive on public procurement (Directive 2014/24/EU) introduced the use of LCC as part of public-procurement procedures. Within the legal context, LCC is considered as a method for contract-awarding. It has been indicated that the pre-tendering phase offers the maximum potential for merging VfM into the process (McKevitt & Davis, 2016; Dimitri, 2013) and LCC enables relevant cost scenarios to be considered for alternative technical solutions (Ally & Pryor, 2016; Ilg et al., 2016). However, the prior literature does not cover the practice of VfM management well enough. More precisely, the potential of utilizing long-term economic evaluations such as LCC as decision support in the early stages of the public-procurement process has not gained much attention, thus highlighting the need for more research.

A great amount of research has been devoted to the adoption of LCC in different industries, especially in the construction sector (Goh & Sun, 2016; Higham, 2015; Olubodun et al., 2010) and in the defense context (Navarro-Galera & Maturana, 2011; Tysseland, 2008; Hochschorner & Finnveden, 2006). In many studies concerning the use of LCC, environmental issues are present (Zuo et al., 2017; Hochschorner, 2011; Gluch & Baumann, 2004). In turn, several studies have focused on the feasibility of LCC in certain specific cases. For example, Ilg et al. (2016) evaluated alternative infrastructure

materials with the help of LCC, El-Akruti et al. (2016) developed an optimum maintenance policy by using LCC, Folgado et al. (2010) discussed how LCC can be used in selecting the appropriate manufacturing technology, and Krozer (2008) highlighted the implications of innovations in product chains with LCC. Actually, in many studies, the focus has been on the development of a specific LCC model (Ally & Pryor, 2016; Kovacic & Zoller, 2015; Ammar et al., 2013; Smit, 2012; Jiang et al., 2004). On the other hand, there are studies discussing the implications of LCC information on consumers' purchase decisions (Deutsch, 2010; Kaenzig & Wüstenhagen, 2010) and the effects of providing imperfect information on total costs to decision-makers (Morssinkhof et al., 2011).

Although the potential of LCC is recognized in the literature (e.g., Dunk, 2004), the approach has not been widely adopted in practice (Zuo et al., 2017; Higham, 2015; Lindholm & Suomala, 2005). Actually, the literature has presented many shortcomings in the employment of LCC such as the lack of input data and uncertainty related to the estimation of future costs (e.g., Korpi & Ala-Risku, 2008; Ahmed, 1995). Especially, the utilization of the organization's internal data sources in the LCC context has not been discussed much in the literature. Hence, additional research in the area of LCC is needed to address the practices of long-term cost management and the challenges related to collecting adequate data. According to Barrett (2016), the long-term economic effects may be ignored because the links between the investment decision and the related outcomes cannot be sufficiently understood. Hence, research that reflects, from the customer's perspective, the possibilities of LCC in constructing a long-term cost structure and in highlighting the trade-offs between different economic elements is needed.

### **1.2.2 The need for research on MA supporting business development**

Developing a new business requires a long-term view and a number of decisions need to be made. One such decision concerns timely strategic choices taken by many machinery manufacturers regarding the development of a new service business for their machinery in use by their customers (e.g., Laine et al., 2012; Oliva & Kallenberg, 2003; Vandermerwe & Rada, 1988). In this thesis, servitization in manufacturing companies is one context where the companies need diverse MA information to support long-term decision-making.

It seems that the companies do not get sufficient support from MA. Actually, there are indications that manufacturing companies meet with significant challenges when attempting to exploit the opportunity of servitization (Baines et al., 2017). The study by Cinquini et al. (2015) indicated that the emerging trend of servitization drives change in producing MA information. Holm et al. (2016), in turn, highlighted that profitability and customer value management are important topics for MA practitioners because many companies pursue customer-oriented strategies. However, the viewpoint of MA in the context of service business development has not gained much attention in the literature. Indeed, there has been keen interest in the effects of servitization on the company's

overall financial performance (Benedettini et al., 2017; Böhm et al., 2017; Cheng & Shiu, 2016; Kohtamaki et al., 2015; Eggert et al., 2014). Especially in globally operating companies, facilitating service business decisions with the help of MA may be complex because of the diverse reporting structures and heterogeneous local practices (Endenich et al., 2016). In addition, the relevant data may be scattered throughout several information systems and even outside the boundaries of MA. Thus, as highlighted by Laine et al. (2012), implications of the servitization on the structure and use of MA should be examined further.

Substantial research on how manufacturing companies should manage the change process toward service business exists (Huikkola et al., 2016; Finne et al., 2013; Rapaccini et al., 2013; Salonen, 2011; Martinez et al., 2010; Brax, 2005; Oliva & Kallenberg, 2003). In addition, several studies have examined the service-infusion process as a business model reconfiguration (Forkmann et al., 2017; Parida et al., 2014; Kastalli et al., 2013). Many studies, in turn, have focused on the value-creation mechanisms in industrial, service-based business models and in supplier–customer relationships in the manufacturing sector (e.g., Brax & Visintin, 2017; Grönroos & Ravald, 2011). Despite the extensive research on the field of servitization, the MA practices that could support a transition from a product-selling to a more service-based business model have not been dealt with enough in the literature. More particularly, research does not adequately cover MA practices that focus on spare part businesses. According to Wagner and Lindemann (2008), such practices do not exist in many companies and it is not even clear that managers are able to pinpoint the profit contribution of spare part businesses based on traditional MA information. Especially, when services are embedded in the goods, identifying the profitability of separate elements becomes challenging (Gremyr et al., 2010). In addition, many manufacturing companies fail to reflect the presence of service activities in their performance management systems (Kastalli & Van Looy, 2013). Hence, there is a need to respond to the identified lack of MA tools and techniques for supporting service business development in manufacturing companies (Laine et al., 2012; Baines et al., 2009).

A key feature of servitization strategies is a strong customer centricity and long-term customer relationships (Nordin, 2008; Penttinen & Palmer, 2007). Thus, there is a need to study how suppliers can capture the nature of new kinds of customer relationships and the financial potential of service businesses with the help of MA. Regarding this, Wagner and Lindemann (2008) proposed that manufacturing companies could utilize the knowledge of the installed equipment base in service business development. Indeed, much research has been devoted, for example, to forecasting spare part demand and logistics based on installed base data (Dekker et al., 2013; Jalil et al., 2011). However, previous studies have not examined how manufacturing companies could combine MA and equipment-fleet data in the context of service business development. In addition, Kindström (2010) indicated that because service-based business is relationship intensive,

companies need a thorough analysis of their customers. Thus, more research is needed to extend the current practices of measuring and managing service operations (e.g., Jääskeläinen et al., 2012). In particular, how suppliers can develop indicators and tools that reflect the service business potential of their global equipment fleet and the characteristics of their customer base should be examined.

### **1.2.3 The need for research on MA development**

Within the field of MA, there are several approaches that aim to produce comprehensive economic information for decision support. However, it may be that the models presented in the literature do not meet the actual needs of practitioners. In order to support long-term decision-making, the role and content of the selected MA method need to fit its intended use (Chenhall, 2003; Chapman, 1997). Many studies outline how long-term decision-making features complexity and uncertainties which may cause challenges for MA (Carr et al., 2010; Alkaraan & Northcott, 2006). However, MA could help in identifying, dealing with, and overcoming such uncertainties regarding the objectives of the decisions at hand as well as the causes and effects related to the key business phenomena (Laine et al., 2016; Burchell et al., 1980). At the same time, the studies suggest that getting support for decision-making often fails and would require both technical and societal MA development (Wouters & Roijmans, 2011; Wouters & Verdaasdonk, 2002) to integrate different fundamental perspectives related to the decision-making situation. In these circumstances, there is a need to study how MA can serve decision-makers in outlining and structuring the decision effects.

One approach to address long-term business consequences with the help of MA is LCC. Even though a shared understanding in applying LCC exists and there are general-level guidelines, for example, in the context of public procurement (Directive 2014/24/EU), it could be that practitioners do not have the needed skills to apply the existing theoretical models and frameworks successfully enough. One reason could be that the models have not been built with a sufficient enough understanding of the nature of decision-making. In addition, it seems that the practitioners are not able to apply theoretical models with reasonable work in relation to the expected benefits. On the other hand, as highlighted by Asiedu and Gu (1998), the problem of utilizing LCC should not be seen as a question of merely which particular accounting method to adopt. Woodward (1997), in turn, suggests that LCC is not merely a certain costing tool but more an approach that encourages comprehensive thinking. According to Butler and Ghosh (2015), there are individual differences in comprehensive thinking abilities and proper decision aids for managerial accounting judgements may help to increase the likelihood of a good decision. Thus, there is a need to develop approaches and outline ideas that are in line with decision-makers' practical needs and available resources.

MA provokes insights that will likely have an impact on the products and services the companies offer (Wouters & Kirchberger, 2015), and regarding innovation processes,

MA may challenge managers' perspectives and make ideas visible and credible (Mouritsen et al., 2009). However, MA numbers are often presented in a standardized form, and they are too costly to be customized and it is not known how the information is to be processed (Quattrone, 2016). Bedford and Malmi (2015) highlighted that the combinatory potential of accounting across different contexts should be recognized. Actually, companies may have difficulties in recognizing, for example, the business opportunities if they limit themselves with prior and inadequate MA numbers and frameworks. There is a need to know how accounting reflects, reinforces, or even constrains the strategic postures adopted and the structures created in organizations (Hopwood, 1983). According to Chenhall and Moers (2015), the role of management control over innovations in business models is an area that offers many opportunities for research. Hence, new approaches to process MA information and to combine it with other information is needed to facilitate decision-making in service business development.

There are indications of a gradually increasing pattern toward more complex service-based offerings and value for the customer regarding industrial services (Brax & Visintin, 2017). Manufacturing companies who have the best knowledge of the product's service requirements over its life-cycle can move up the value chain and offer comprehensive solutions in order to differentiate from their competitors and generate profit (Rapaccini, 2015; Aurich et al., 2010; Oliva & Kallenberg, 2003). Thus, it would be necessary for MA practices and performance indicators to support the trend of providing comprehensive solutions to customers. However, there are often different intra-organizational needs regarding MA (Mohr, 2016) and thus it may not be possible to get a comprehensive view within the current MA frameworks. In this context, Neely (2008) pointed out that analyzing the long-term cost and profitability implications is a significant challenge. Servitization incurs a shift in costs of ownership and, as highlighted by Wouters and Kirchberger (2015), MA may help customers to recognize the value of new products and services. Thus, from the supplier's perspective, MA can make visible what is important for customers. As customers may not be prepared to consider the life-cycle cost effects when making a purchase decision (Lindholm & Suomala, 2005), suppliers may have the opportunity to provide this kind of information to customers. Overall, there is a need to understand the requirements for MA development in supporting long-term decision-making in different managerial contexts, including investment decision-making for the customers and the service business development of the suppliers.

## **1.3 Research objective and scope**

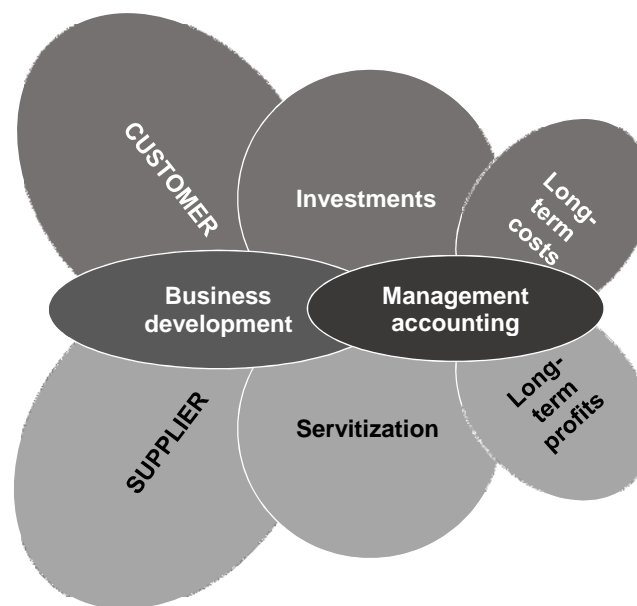
### **1.3.1 Research questions**

The overall objective of this thesis is to examine how to develop MA to support long-term decision-making, given the restrictions of the existing MA practices and the organizational challenges. More particularly, the focus is on MA approaches that can

facilitate investment decision-making in customer organizations and business development in supplier organizations. Finally, the aim is to discuss the characteristics of MA development in the context of long-term decision support. The issue is studied through the following research questions:

- How can the customer's investment decision-making be supported with MA information?
- How can the supplier's business development be supported with MA information?
- What kinds of characteristics are desired for MA development to support long-term decision-making?

By answering these research questions, this thesis presents how MA could support long-term decision-making by structuring the decision effects and by creating meaningful insights from diverse data sets. As illustrated in Figure 1, the long-term cost effects of investments are the primary concern from the customer's perspective. In particular, the purpose is to examine the practical VfM challenges (McKevitt & Davis, 2016; Prowle et al., 2016) and to figure out a path to engage the economic facts and the subjective valuations in the public-procurement context with the help of MA. The aim is to enhance existing knowledge on how public authorities could pursue VfM throughout the procurement process and rely not only on complex MEAT when tender-awarding (Lahdenperä, 2013; Falagario et al., 2012). One objective of this thesis is to highlight the way in which MA, and especially LCC, could help decision-making regarding multifaceted investments. More particularly, a lack of awareness of LCC exists (Goh & Sun, 2016; Higham, 2015) and thus this thesis aims to exemplify how to practice long-term cost management in an uncertain environment. In addition, the target is to demonstrate how constructing a long-term cost structure for a product could provide a common base for discussion and decision-making in customer's organizations.



**Figure 1.** The focus of the thesis on MA for long-term decision-making.

From the supplier's perspective, the objective is to explore how to capture the long-term profitability implications of business development actions with the help of MA (Figure 1). First, this thesis tries to enhance the understanding of the implications of the servitization for producing and using MA information (Cinquini et al., 2015; Kastalli & Van Looy, 2013; Laine et al., 2012). Consequently, the aim is to develop MA approaches that can respond to the identified challenges in exploiting the opportunities of servitization in manufacturing companies (Baines et al., 2017). In particular, to help companies figure out the long-term profitability potential lying in the global equipment fleet and within the diverse customer base, the objective of this thesis is to develop new MA approaches and indicators for performance measurement and management. Knowledge of customers is central to service business development (Kindström, 2010; Penttinen & Palmer, 2007) and hence one target of this thesis is to present a method that can seize the nature of customer relationships and provide supportive information for managerial decision-making.

Successful MA development requires that different perspectives and organizational needs are taken into account (Wouters & Roijmans, 2011; Wouters & Verdaasdonk, 2002) and thus the objective of this thesis is to figure out the characteristics of MA development that are desired to support long-term decision-making. By integrating the knowledge from the specific MA development cases conducted in both customer and supplier organizations, the aim is to get an understanding of the underlying essentials that are common when it comes to examining long-term costs and profits for decision support.

### 1.3.2 Research scope

This thesis is a collection of four articles that address the research questions and contribute toward enhancing our understanding of how to develop MA to support long-term managerial decision-making. Table 1 illustrates the set-up of the research questions and the original articles.

**Table 1.** *The set-up of the research questions and the original articles.*

How can the customer's investment decision-making be supported with MA information?	How can the supplier's business development be supported with MA information?
<p><b>Article I</b></p> <p>Engaging economic facts and valuations underlying VfM in public procurement</p>	<p><b>Article III</b></p> <p>The potential of management accounting and control in global operations: Profitability-driven service business development</p>
<p><b>Article II</b></p> <p>Learning by costing: Sharpening cost image through life-cycle costing?</p>	<p><b>Article IV</b></p> <p>RFM customer analysis for service business development: An interventionist case study of two machinery manufacturers</p>
What kinds of characteristics are desired for MA development to support long-term decision-making?	



The first two articles reflect the customer's perspective on MA development. Article I concerns the VfM considerations in the public-procurement context. In article II, the focus is on the development of an LCC model that enhances understanding of the long-term cost implications of a certain investment decision. The last two articles explore MA development from the supplier's perspective in the service business development context. The third article examines the supportive role of MA and control in capturing the most profitable ways to develop machinery-manufacturers' service businesses. In turn, article IV furthers the ideas provided in article III by presenting a customer-segmentation method that helps machinery manufacturers to manage and develop their spare part businesses. Finally, through these four articles, it is possible to discuss the general features of MA development for long-term decision-making.

## **1.4 Research methodology and data**

### **1.4.1 Research approach**

This doctoral thesis takes advantage of rich empirical data that have been collected through several in-depth qualitative case studies. An important value of qualitative research is the possibility of gaining an understanding of managerial actions and processes in real-life organizational settings (Gephart, 2004). The source of the findings is an interpretation of both the qualitative and quantitative data and thus the philosophical basis of this thesis can be characterized as hermeneutical. Hermeneutics is a general methodology for interpretation and understanding, which is often perceived to be typical of qualitative research (Gummesson, 2003). Positivistic research, in turn, has the ideal of objectivity and is based on an assumption that it is possible to report an unambiguous truth in terms of verified facts (Gephart, 2004). Typically, qualitative research is related to hermeneutics whereas quantitative research often represents positivist thinking (e.g., Huxham & Vangen, 2003).

There are different forms of logical reasoning that are used in research. Characteristic of the studies underlying this thesis is abduction, which is about developing theoretically informed explanations to emerging empirical observations (Modell, 2009). More precisely, abduction starts from the empirical findings and pursues the most plausible explanation for those based on the prior theoretical knowledge (Lukka & Modell, 2010). Deductive research, in turn, explores a known theory or phenomenon and tests if that is valid in a given circumstance, whereas inductive research focuses on building new theories from empirical data (Eisenhardt & Graebner, 2007). However, the abductive approach is not the same as a mixture of deductive and inductive approaches (Dubois & Gadde, 2002).

As MA is highly contingent and situationally specific, a qualitative research approach enables one to study MA as a dynamic and context-bound phenomenon (Vaivio, 2008).

Thus, qualitative research can provide valuable insights and contributions to MA knowledge (Parker, 2012). According to Guercini (2014), the qualitative dimension is essential in management research in addressing the increasing complexity that business decision-makers are facing. Qualitative research offers a deep perspective into the subject of MA, which is not a neutral system that assists rational choice and control but is rather a mixture of practices that are used in a variety of ways by different organizational actors (Vaivio, 2008). Regarding this, Ahrens and Chapman (2006) highlighted that the strength of qualitative research lies in its capacity to study the processual and context-specific MA phenomena. In addition, Parker (2012) pointed out that orientation toward understanding, critiquing, and changing MA practices with qualitative research offers practitioners and policy makers particular value at the organization-specific level.

Case studies can be applicable especially when the research interest is concerned with the dynamics of a phenomenon (Eisenhardt, 1989). Regarding this, Dubois and Gadde (2002) stated that case studies provide in-depth understanding of the interaction between a phenomenon and its context. Characteristic for a case study is to examine particular instances of a phenomenon in its real-life context (Yin, 1981) and take advantage of the rich empirical data by using several methods of data collection (Eisenhardt & Graebner, 2007). Actually, this thesis relies on a hybridization of different qualitative methods, which is, according to Guercini (2014), a particularly relevant approach for management research. Parker (2012) highlighted that the feature that distinguishes qualitative MA research from much of the positivist tradition is the researcher's personal engagement in the field, which enables an understanding of organizational processes and the MA interface. In this context, Ahrens and Chapman (2006) discussed how the theoretical interests of the researcher definitely shape the empirical world. As pointed out by Eisenhardt and Graebner (2007), the hallmark of case studies is the theory-building process that bridges rich qualitative evidence with the extant theories.

This study can be characterized as an interventionist case study (Suomala et al., 2014; Jönsson & Lukka, 2006). As is typical for an interventionist approach, the studies underlying this thesis aimed at examining complex phenomena and improving the performance of a business, which required deep involvement in the case organizations. As MA development for long-term decision support is challenging, unique access to rich empirical data best facilitated both the practical progress of the studies and the theoretical inquiry. As interventionist research can produce contributions that are practically relevant and theoretically significant (Suomala et al., 2014; Jönsson & Lukka, 2006), the approach has become more popular in the field of MA studies and the studied topics vary a great deal (Malmi, 2016). Characteristics of interventionist research are the active involvement of the researcher and a clear orientation toward solving practical problems (Jönsson & Lukka, 2006). However, the development work itself is not the main outcome of the research. Instead, the process around interventions leading to a series of negotiations between actors with different interests enables the contributions of the research and

relates both the theoretical and empirical domains (Suomala et al., 2014). When the researcher's role is to have a positive impact on the studied phenomenon and there is unique access to the case company, tacit and embedded knowledge can be uncovered (Gummesson, 2003).

Because of the active participation in the field and the aim of making theoretical contributions, the interventionist researcher examines the issue at hand from both inside and outside the system (Suomala et al., 2014; Jönsson & Lukka, 2006). Malmi (2016) highlighted that the aim of interventionist research is to get a deep understanding of the various forces at play by participating in real-life development activities and to theorize based on those insights. Lukka and Suomala (2014), in turn, pointed out that the researcher's deep access to particular actions in the field can be linked to more general phenomena and thus to broader theoretical issues. Developing theoretical insights from interventions usually closely relate to practice and because they are derived emergently, they can be described in a way that practitioners can relate to (Lyly-Yrjänäinen et al., 2017). Huxham and Vangen (2003) stated that the intervention in an organization is a means to the research ends, and that the conceptualization of the experiences forms the theoretical output. Typical for interventionist research is that capturing the dynamics of practice often requires deep and long-term co-operation between the academics and the industry (Lyly-Yrjänäinen et al., 2017). To summarize, by building on an interventionist approach, it was possible to support real-life problems in the case companies and to gain new theoretical insights by getting an in-depth understanding of the complex phenomenon.

## **1.5 Research process**

The studies underlying this doctoral thesis were carried out along with three research projects in which the focus was on diverse managerial challenges that were supported by MA approaches developed by the researchers. Actually, the development work in all of the research projects was carried out outside the financial function of the case organizations. The in-depth case studies, characterized as interventionist research, enabled the use of diverse methods of data collection and analysis. Table 2 gives an overview of the data-collection methods employed in the original articles.

**Table 2.** *Data-collection methods employed in the original articles.*

	Article	Research strategy	Timeframe	Data type
I	Engaging economic facts and valuations underlying VfM in public procurement	Interventionist case study	14 months 2015–2016	Written and partly recorded field notes from project meetings (n = 10) in a Finnish industrial company
II	Learning by costing: Sharpening cost image through life-cycle costing?	Case study	11 months 2004	Written field notes from interviews (n = 12) and observations (ca. 14 days) in the Finnish Defence Forces
III	The potential of management accounting and control in global operations: Profitability-driven service business development	Interventionist case study	12 months 2015–2016	Written notes from project meetings (n = 12) and from interviews (n = 4) in a global machinery-manufacturing company
IV	RFM customer analysis for service business development: An interventionist case study of two machinery manufacturers	Interventionist case study	24 months 2016–2017	Written notes from project meetings (n = 41) in two global machinery-manufacturing companies

The first article relies on an interventionist case study conducted in close co-operation with a Finnish company providing waste-handling solutions globally. The study was part of MASI (Managing service impact: Engaging facts and feelings) funded by Business Finland and the participating companies. Characteristic of the study underlying this thesis was a need for active researcher participation in a real-life development project. The study was prompted by the concern that the public procurers may not have been able to use MEAT and to utilize LCC in investment decision-making contexts in a proper manner. During the research project, the researchers, together with the management of the company, created tools and materials for pursuing VfM in public procurement. Moreover, these interventions inspired and guided the project meetings, which were an important part of the data-collection process. As described in Table 2, ten meetings with the management were held over a 14-month period between 2015 and 2016. In addition to gaining knowledge of the business and tendering practices, the meetings enabled us to test the applicability of the outlined ideas with the company staff. One aspect of the research was an analysis of public tender calls from the case company's field on industry. Additionally, a sample of publicly available material from other industries was analyzed and reflected upon the case company's dataset. In all, to best facilitate both the practical needs and theoretical inquiry, an interventionist approach enabled an enhanced understanding of the complex VfM phenomenon.

The data collected through a research project carried out with the Finnish Defence Forces (FDF) formed the basis for the second article. The project was financed by MATINE (Maanpuolustuksen tieteenallinen neuvottelukunta), which finances studies on defense issues in managerial and technical areas. The motivation for the study was the concern of the management of the case organization that the level of life-cycle cost consciousness

was not adequate for investment decisions. Several methods of data collection were employed during the 11-month period in 2004. As part of the study, an LCC model for a case product, which was a field gun, was created. To understand the context and collect input data for cost modeling, participation or observation in the organization was needed. In all, 12 interviews were used both for collecting cost data and for reflecting on the impacts of LCC in the organization.

The third article drew from an interventionist case study conducted as part of S4Fleet (Service Solutions for Fleet Management) program financed by the DIMECC (Digital, Internet, Materials & Engineering Co-Creation) and the participating companies. More particularly, the study underlying this thesis was part of a sub-project P1c called PROfitability-driven Service business renewal (PROS) and was conducted with a globally operating machinery-manufacturing company during 2015 and 2016. The interventionist approach was selected because it was possible to build an in-depth visibility of the ongoing business development project. There was a need to examine how the business development actions related to spare part sales and especially to a new online application that could be supported with MA information. In practice, the research was carried out with the spare part function and the main informant was the spare part manager responsible for global sales. Several MA-related interventions produced by the researchers played a key role in the study and facilitated improvements within the case company. Project meetings and interviews with the company staff, in turn, provided an opportunity to collect data and reflect upon the development of the interventions (Table 2).

The fourth article is based on two interventionist case studies conducted as part of the S4Fleet program's sub-project P1c during 2016 and 2017. Following the earlier development work carried out with the globally operating machinery-manufacturing companies, there was a need to create supportive tools for spare part sales and examine the customer base more closely. Actually, the studies presented in this article were preceded by a comprehensive analysis of the current state of spare part sales. Thus, this study furthered the research underlying the third article. The main interventions in both case studies were customer-segmentation tools developed by the researchers. Several project meetings with the company staff enabled a discussion on the applicability of the created tools and thus played a key role in data collection (Table 2). In fact, the tool was initially developed for one case company and then implemented in another one. Hence, the possibility of reflecting on the findings of two different case studies emerged.

## **1.6 The original articles**

The contribution of the author to the articles is illustrated in Table 3. Regarding articles I–III, the author had a central role in conducting the studies and in the writing process. Article IV is based on two case studies and the author was responsible for carrying out the study in one company and for writing some parts of the article.

**Table 3.** *The contribution of the author to the articles.*

Article	Role of the author
I Engaging economic facts and valuations underlying VfM in public procurement	- Designed and facilitated the study with the second co-author - Wrote and reviewed the majority of the article with the help of co-authors
II Learning by costing: Sharpening cost image through life-cycle costing?	- Designed and facilitated the study with the co-author - Wrote the article with the co-author
III The potential of management accounting and control in global operations: Profitability-driven service business development	- Designed and facilitated the study with the second co-author - Wrote and reviewed the majority of the article with the help of co-authors
IV RFM customer analysis for service business development: An interventionist case study of two machinery manufacturers	- Designed and facilitated the study conducted in one case company with the fourth co-author - Wrote the empirical section regarding one case company and some parts of the theoretical section

### **I Engaging economic facts and valuations underlying VfM in public procurement**

Lindholm, A., Korhonen, T., Laine, T., Suomala, P.

*Public Money & Management* (Accepted for publication)

The objective of the paper is to examine how to engage facts and subjective valuations in order to achieve the best VfM in the context of public-procurement decision-making. Because VfM as a concept is ambiguous, decision-makers need MA approaches such as LCC that can present the long-term economic implications of alternatives. Regarding MA development, this paper illustrates that the potential of MA as a decision aid is greatest in the early planning stage of the procurement process. The paper highlights that public authorities should be qualified to choose the appropriate method for contract-awarding depending on the nature of the case. The paper takes advantage of an in-depth case study in the Finnish waste-management context. In addition, a sample of public tender calls from different industries was analyzed and reflected upon the findings of the case. The paper presents a description of conceptual VfM challenges and a path to overcome these in a real-life case. The results indicate that because of the multidimensional and complex nature of public procurement, defining an absolute VfM is difficult. As a contribution to the MA literature, this paper highlights that there is a need to develop approaches such as LCC that can give structure to the expected impacts of complex investment cases. This paper suggests that it is worth considering whether to pursue VfM by relying on appropriate quality requirements or to use qualitative criteria and methods such as LCC in tender evaluation.

## **II Learning by costing: Sharpening cost image through life-cycle costing?**

Lindholm, A., Suomala, P.

*International Journal of Productivity and Performance Management*, 2007, Vol. 56, No. 8, pp. 651-672.

The aim of the paper is to discuss life-cycle cost management and highlight the challenges related to practicing LCC in an uncertain environment. This paper provides insights into how MA, and especially methods such as LCC, can help to shape the problematic issues into a form that supports long-term investment decision-making. The key idea of the paper is that a characteristic of LCC is that it evolves from cost estimation to cost monitoring during the product life-cycle. The paper is based on a case study conducted in the FDF. The motivation for the study was that the MA practices did not support investment decisions of defense material in an adequate manner. To improve the long-term cost consciousness of the case organization, a general template for an LCC model was developed in the study. The paper illustrates the LCC model development process and reflects the impacts of LCC in the case organization. The results of this paper contribute to the field of MA development by suggesting that LCC could be a planning tool for selecting the most suitable technology rather than for choosing the most suitable supplier or product. The findings show that practicing LCC is time-consuming and the most important supporting methods associated with LCC may not be found inside the boundaries of MA. The paper contributes to the LCC discussion by providing insights into how LCC can be used in a continuous manner during the product life-cycle.

## **III The potential of management accounting and control in global operations: Profitability-driven service business development**

Lindholm, A., Laine, T., Suomala, P.

*Journal of Service Theory and Practice*, 2017, Vol. 27, No. 2, pp. 496-514.

This paper describes MA development in the context of machinery-manufacturers' servitization processes and discusses the various roles of MA in providing information for decision support. The paper illustrates how the service business potential can be understood through MA information and how MA can help to select and prioritize business development activities. An interventionist case study carried out at a global machinery manufacturer provides empirical insights into the MA development process. The case study illustrates that traditional MA practices may not provide sufficient information to support service business development. The findings of the study indicate that to get a comprehensive view of the business, there may be a need to collect data outside the traditional MA frameworks and combine it with other data such as equipment fleet and customer information. The paper proposes that especially in global companies, MA enables the consolidation of the scattered financial and non-financial data collected across different reporting lines and complex organizational structures. As a contribution to the literature, the paper suggests that developing a service business requires taking into

account the overall profitability implications of development actions rather than simply focusing on the performance of certain areas of responsibility. In addition, machinery manufacturers can explore their service business potential with the help of performance indicators combining MA and equipment-fleet information.

#### **IV RFM customer analysis for service business development: An interventionist case study of two machinery manufacturers**

Stormi, K., Lindholm, A., Korhonen, T., Laine, T.

*Workshop & special issue for Journal of Management and Governance, June 29-30, Pisa, Italy*

The objective of the paper is to illustrate how machinery manufacturers can segment their spare part business customers with the recency, frequency, and monetary value (RFM) analysis typically applied in consumer business. The paper contributes to MA development by providing insights into how the methods outside the traditional MA practices can provide decision support in the context of service business development. In the paper, the original idea of RFM analysis is extended with four variables that are specific to industrial services. The paper draws from empirical data collected through interventionist case studies conducted in two global machinery manufacturers that seek business growth in the area of services. The results of the paper indicate that RFM analysis is able to sort industrial service customers into meaningful segments. However, the R, F, and M variables may have a different interpretation in business-to-business than in business-to-consumer (B2C) contexts. The paper illustrates that MA and methods such as RFM can support managerial decision-making at different levels. Based on RFM analysis, the companies can manage their daily sales activities more effectively by allocating sales resources where they could be most impactful. In turn, RFM may provide supportive information for the development of the whole service system. By introducing a method for measuring and analyzing the business potential of an industrial customer base and equipment fleet, this paper contributes to the MA and servitization literature.





## 2 LITERATURE REVIEW

### 2.1 MA in supporting managerial decision-making

In short, MA means producing financial information for managerial-purpose use. MA information and practices play a key role in strategic and organizationally complex decision situations (Nielsen et al., 2015). Especially in environments characterized by uncertainty and doubt, MA can facilitate decision-making (Hopwood, 1983). Regarding long-term decision-making, MA may face challenges because of the uncertainties related to the estimation of the future business activities (Carr et al., 2010; Alkaraan & Northcott, 2006). Actually, the role of MA varies depending on whether there is uncertainty over the objectives for organizational actions or uncertainty over the consequences of an action (Burchell et al., 1980). The strength of MA is that it uses formalized categories for collecting and reporting information and thus enables people to communicate with a common language (Wouters & Verdaasdonk, 2002). However, decision-making does not deal only with MA data to be used neutrally but politics and biases intertwine with figures and numbers (Quattrone, 2016; Denis et al., 2006).

There are several definitions for MA. According to the Institute of Management Accountants (IMA) (2008), “Management accounting is a profession that involves partnering in management decision-making, devising planning and performance management systems, and providing expertise in financial reporting and control to assist management in the formulation and implementation of an organization’s strategy” (IMA, 2008). Actually, MA is undertaken by many organizational areas, not just accounting function (Langfield-Smith, 2008; Järvenpää, 2007). The Chartered Institute of Management Accountants (CIMA) defines that “Management accounting is the sourcing, analysis, communication and use of decision-relevant financial and non-financial information to generate and preserve value for organizations” (CIMA, 2018). In turn, Jorge et al. (2017) suggested that MA is a tool for knowledge integration.

The use of MA systems in supporting strategic decision-making can be defined as strategic management accounting (SMA) (e.g., Tillmann, 2008). Endenich et al. (2016) argued that MA has developed from strongly introversive and short-term data provision toward a support function for strategy formulation and implementation. Langfield-Smith (2008) highlighted that there are ambiguous definitions for SMA but the unifying link between various views is the strategic orientation of SMA to the generation and analysis of MA information. In turn, Lord (1996) pointed out that the extension of traditional MA’s internal focus to include external and non-financial information is an important component of SMA. According to Tillmann (2008), understanding SMA in practice relate to how organizational actors use accounting information to make sense of strategic

situations. Actually, the techniques and elements of SMA can often be found in companies but the information may not be expressed as accounting figures (Lord, 1996).

Regarding the practices of MA, the nature of the accounting craft is diverse and there is an enormous range of technical approaches in use (Hopwood, 1983). Actually, the practices of MA are the result of the interplay of a variety of parties and contexts (Hoozée & Mitchell, 2017). For example, Vaivio (2008) described that MA practices may be used selectively within different organizational processes. Nielsen et al. (2015) highlighted that the forms and roles that MA takes in practice can be complex and dynamic. In this context, Denis et al. (2006) argued that generating accounting figures is the result of a variety of social processes. In addition to technical characteristics, the practices of accounting should be seen as part of a larger context (Messner, 2016). Thus, accounting development requires that a conscious elaboration upon the involved actor's values and valuations be taken into consideration in addition to providing new accounting facts (Laine et al., 2016).

Developing MA practices may require that accountants and nonaccountants are able to work together and combine their knowledge (Wouters & Roijmans, 2011). Regarding this, Järvenpää (2007) has discussed the business-oriented role of management accountants, referring to their willingness and ability to provide more added value to managerial decision-making. Actually, the literature has recognized the existence of hybrid management accountants, which refers to the situation in which other professions than accountants expand their activities and competencies to the functions of the traditional domain of MA (Byrne & Pierce, 2007; Kurunmäki, 2004). In practice, for example, it could be that accountants' tasks consist of bookkeeping and financial reporting, while MA tasks such as planning and control are performed by personnel outside the accounting function (Hyvönen et al., 2009). On the other hand, the traditional accounting profession may move toward new organizational roles. Thus, the term "hybrid accountant" can refer to the situation in which accountants are assuming new organizational roles such as so-called business partners and are increasingly becoming involved in wider, integrated business situations and decision-making forums (Burns & Baldvinsdottir, 2005).

MA practices are often assumed to be based on relatively clear financial data and lines of responsibility within hierarchical structures (Chenhall & Moers, 2015). However, especially in multinational companies, MA is shaped by its respective context and differs traditionally between organizational units and countries (Endenich et al., 2016; Tillmann, 2008). Indeed, the interdependencies between headquarters and subsidiaries in multinational companies may reduce the influence of local management on MA practices (Hoozée & Mitchell, 2017). On the other hand, MA information provides means for coordination of organizational units (Jorge et al., 2017). According to Ahrens and Chapman (2007), accounting can make significant contributions to the way in which organizations steer their actions.

MA increases the belief in the possibility of giving better visibility to organizational actions, and what is important is not the bottom line number that may already be obsolete by the time the process is complete, but how one got there (Quattrone, 2016). For example, Laine et al. (2017) highlighted that regarding environmental financial information, the significance is related more to the process through which it is constructed than to the eventual numbers. According to Wouters and Kirchberger (2015), in some cases, it is not about the accuracy of MA, but to what extent it can produce insights that help organizations to learn. Hiebl (2017) suggested, in turn, that changes in organizational fields such as new technologies and increased competition may become visible via MA information. In addition, Burns and Baldvinsdottir (2005) pointed out that accounting makes the underlying inefficiencies more transparent to the business. On the other hand, Hall (2016) suggests that MA practices and material artefacts such as reports could provide a vehicle through which even the feelings of the participating actors could be expressed.

Rationally acting decision-makers require knowledge of alternative courses of action and their consequences (Nielsen et al., 2015). As MA information may often be considered rational, it can be used in gaining support for decisions in different situations (see e.g., Hiebl, 2017). For example, Wouters and Kirchberger (2015) highlighted that MA enables the quantification of the various consequences of decision alternatives in monetary terms and thus makes trade-offs more transparent and meaningful. However, it is not clear why decision-makers' understanding is best achieved by expressing the issues in monetary terms (Nyborg, 2014). Actually, Quattrone (2016) suggested that accounting is a communicative process that cannot help decisions to be made simply via a calculation but can prepare the groundwork for communicative actions that can assist decision-making.

MA can be seen as a mechanism that enables actors to negotiate their interests and articulate their counter claims (Burchell et al., 1980). In this context, Hall (2010) suggests that one of the key functions of accounting is consensus building. Thus, politicians may use accounting information to accommodate their political preferences in the debates about controversial alternatives (van Helden, 2016). However, according to Hiebl (2017), it may be seen paradoxical that MA is used as a basis for identifying a need for and deciding on change, even if the involved actors know that the usage of MA is only to legitimize choices that have been previously decided. Thus, as pointed out by Denis et al. (2006), accounting is not neutral system that assists rational decision-making but rather complex results of managerial preferences and organizational politics.

In addition to rational procedures, an individual's decision-making is much dependent on experience-based intuition (Kaufmann et al., 2014). Due to the existence of cognitive biases, rational decision-making frameworks are often not valid in the real-life circumstances (Williams & Samset, 2010). For example, the study by Laine et al. (2017) indicated that both managers and accountants might be suspicious regarding the impact of environmental cost information on decision-making. According to Quattrone (2016),

the politics, pressures, and egos of those who produce and consume the MA data inevitably move us away from rational decision-making. Gluch and Baumann (2004), for example, pointed out that personal values and motives systemically affect the estimations and assumptions used in LCC analysis. Thus, decisions are often results of subjective procedures with many concurrent ends (Socea, 2012).

MA can clarify long-term and comprehensive thinking by shaping the managerial practices and structuring the decision effects. As highlighted by Socea (2012), complex decision situations require a specific framework, combinations of data, and knowledge that often must be drawn upon as inputs from different sources. MA can reduce the uncertainty surrounding long-term decision-making in several ways. If there is uncertainty over the objectives for organizational action, MA can articulate and promote interested positions and values (Burchell et al., 1980). In turn, uncertainty related to the consequences of decisions can be modeled and presented with the help of MA. The accounting process itself may provide valuable insights that can serve long-term decision-making in many ways. It is important to note that MA development may take place not only as a change in accounting systems or new innovative approaches, but also in the form of changing the action patterns of the management accountants (Järvenpää, 2009). Overall, MA development requires the combination of knowledge and expertise from different organizational fields.

## **2.2 Approaches to support customer's investment decision-making**

Numerous approaches can support customers' decision-making regarding long-term investments. In this thesis, the focus is on VfM and LCC. As investment projects often have a significant long-term impact on an organization's performance and involve high levels of risk (Alkaraan & Northcott, 2006), it is essential to assess the future impacts of the decisions and compare alternative options. Especially in the context of public procurement, decisions makers should be able to justify the choices that they have made. However, there are substantial differences in the way companies make their decisions on investments regarding the thoroughness of their financial analysis and the attitudes toward incorporating non-quantifiable outcomes into their calculations (Carr et al., 2010). According to Alkaraan and Northcott (2007), a financial analysis might constitute a framework within which to formalize investment decisions, but the analysis alone is unlikely to determine the decision outcomes.

VfM means, in ordinary parlance, not paying more for an article or service than appears to be justified by its quality and availability (Glendinning, 1988). The term "VfM" is often used in the context of public procurement. The HM Treasury (2006) responsible for public spending in the UK states that "Value for money is defined as the optimum combination of whole-of-life costs and quality (or fitness for purpose) of the good or

service to meet the user's requirement. Value for money is not the choice of goods and services based on the lowest cost bid. To undertake a well-managed procurement, it is necessary to consider upfront, and at the earliest stage of procurement, what the key drivers of value for money in the procurement process will be." The main idea behind VfM is to support the purchasing of products and services that offer the best long-term price–quality ratio (e.g., McKevitt & Davis, 2016; Kiiver & Kodym, 2015; Dimitri, 2013). The term "VfM" has been commonly defined with reference to the economy, efficiency, and effectiveness (McKevitt & Davis, 2016; Glendinning, 1988). The economy means meeting a certain need defined in quantitative and qualitative terms with the lowest possible cost (Glendinning, 1988). Efficiency refers to delivering a certain level of service with the minimum input of cost, and effectiveness is concerned with the achievement of intended outcomes (McKevitt, 2015).

Because of its multidimensional nature, the definition of the term "VfM" involves a great deal of confusion. MacDonald et al. (2012), for example, highlighted that because VfM has both the dimensions of value and the timeframe of evaluation, there is a striking lack of consistency in the definition. Since VfM is not measurable by ordinary economic methods, attaching a precise meaning to it is difficult (Glendinning, 1988). McKevitt (2015) argued that the conceptual clarity of VfM is missing and the meaning of VfM may change with business cycles. The study by Prowle et al. (2016), in turn, indicated that it is not very clear what VfM means and many are of the opinion that VfM is equivalent to cost cutting. On the other hand, different stakeholders may have different interpretations of what VfM is. For example, Heald (2003) pointed out that interpreting VfM is complicated since affordability to the customer is not necessarily the same as VfM for the public sector as a whole.

Evaluating VfM in the legal context means the award of a public contract to the MEAT. The EU directive on public procurement (Directive 2014/24/EU) states that "MEAT from the point of view of the contracting authority shall be identified on the basis of the price or cost, using a cost-effectiveness approach, such as LCC and may include the best price–quality ratio, which shall be assessed on the basis of criteria, including qualitative, environmental and/or social aspects, linked to the subject-matter of the public contract in question." MEAT is typically formalized by a scoring formula that is a rule for assigning numbers to different monetary and non-monetary elements of an offer. Usually, there are quantitative and qualitative criteria that are expressed in different units of measurement (Kiiver & Kodym, 2015). In practice, either quality must be evaluated in monetary terms or price must be transferred into a score that is commensurate with the quality score and MEAT is the one that achieves the highest combined price and quality score (e.g., Bergman & Lundberg, 2013).

Actually, VfM should be seen more broadly than merely as a tender exercise. According to Dimitri (2013), pursuing VfM requires careful management from procurement planning to the post-tender phase. MA can support managerial work and decision-making

that may contribute to the achievement of VfM in different stages of the procurement process. In this context, McKevitt and Davis (2016) suggested that in the absence of conceptual unambiguity, the meaning of VfM could be described with reference to MA approaches with a long-term and comprehensive outlook. In this context, MacDonald et al. (2012) pointed out that there is a need for tangible expressions of VfM in financial terms to support public-sector decision-making. Due to the presence of qualitative and non-quantifiable issues that have to be taken into account, VfM assessments are more challenging compared to conventional economic evaluations. Nevertheless, the overall idea behind VfM is applicable for diverse decision-making contexts and encourages examining the issue at hand from a variety of perspectives.

LCC is an approach focusing on total costs rather than simply on price (Woodward, 1997) and enables the monetary quantification of non-financial attributes (Morssinkhof et al., 2011). The Organization for Standardization (ISO) standard 15663-3 (2001) defines LCC as follows: “Life-cycle costing is the systematic consideration of all relevant costs and revenues associated with the acquisition and ownership of an asset. It is an iterative process of estimating, planning and monitoring costs and revenues throughout an asset’s life. It is used to support the decision-making process by evaluating alternative options and performing trade-off studies. While it is normally used in the early project stages evaluating major procurement options, it is equally applicable to all stages of the life-cycle, and at many levels of detail.” According to Woodward (1997), LCC is concerned with optimizing VfM in the ownership of physical assets by optimizing the trade-off between different cost factors related to the asset during its operational life. Wouters et al. (2005), in turn, suggested that LCC is a form of MA that translates different financial and non-financial criteria into monetary units and makes them commensurable.

As a concept, LCC is ambiguous (Goh & Sun, 2016) and it is one of several approaches that can provide a long-term view on costs (Cole & Sterner, 2000). For example, total cost of ownership (TCO) (Ellram & Siferd, 1998) and through-life costing (TLC) (Settanni et al., 2014) are MA approaches producing comprehensive information for decision support. According to Ellram (1995), TCO is a purchasing tool and philosophy, which aims to understand the total costs of buying a particular good or service from a particular supplier. The main difference between LCC and TCO is that LCC adopts the perspective of the product, while TCO focuses more on the supplier-related transaction costs from the purchaser’s perspective (Saccani et al., 2017). In turn, between LCC and TLC there is no clear distinction (Goh & Sun, 2016). However, regardless of the term used, such approaches shift the concern with initial costs and revenues toward the consideration of the long-term and widespread economic consequences of decisions.

In practice, the scope of the LCC analysis and used methods can vary significantly depending on the purpose of the analysis and the nature of the product (Korpi & Ala-Risku, 2008). Because the life-cycles of products diverge too much for oversimplifications, the existing models for LCC differ significantly from each other

(Goh & Sun, 2016; Geissdoerfer et al., 2012). Actually, the methods used in LCC can vary from utilization of basic MA practices (Asiedu & Gu, 1998; Woodward, 1997) to advanced mathematical models (Ammar et al., 2013). An important LCC feature is the monetarization of the indirect effects of the decision alternatives such as environmental issues (Krozer, 2008; Gluch & Baumann, 2004). The consequences of decisions will be highest in the early stages of the life-cycle while the information available is at its lowest (Williams & Samset, 2010). Thus, characteristic for ex ante evaluations such as LCC is that the information basis is limited to the combination of facts and well-founded assumptions (Samset & Christensen, 2017).

LCC can provide supportive information for a wide range of decision-making situations for both customers and suppliers across a range of industries (Dunk, 2004). Cole and Sterner (2000) summarized that LCC analyses can be used to ascertain the most cost-effective strategy among a range of competing options that meet specified functional and technical requirements. In turn, El-Akruti et al. (2016) suggested that LCC could help in improving the organizational performance with the same cost spent or reduce the cost with the same performance maintained. In the public-procurement context, LCC is one approach to seek VfM. In fact, the EU directive on public procurement (Directive 2014/24/EU) introduced the concept of LCC and the opportunity to use that as contract-award criteria. Thus, the public sector is an important driver for the implementation of the approach.

The study of the LCC practices in Finnish industrial companies indicated that the most common use for LCC was to compare alternative investment options (Lindholm & Suomala, 2005). Ally and Pryor (2016), in turn, highlighted that LCC is an ideal tool with which to evaluate the competing technologies in the early planning stage. Actually, it can be thought that pre-decision management controls influence and shape investment decisions by setting limits and criteria against which projects are evaluated (Alkaraan & Northcott, 2007). In turn, Olubodun et al. (2010) defined that LCC is a means of comparing design options based on their whole life cost with the objective of providing VfM for the life of the asset. Ilg et al. (2016) highlighted that visualizing the economic effects of alternatives with LCC provides valuable information to decision-makers. For example, the physical energy figure shown on household appliances may be cognitively demanding for consumers, whereas monetary information promises may simplify the decision problem (Deutsch, 2010). Indeed, the study by Kaenzig and Wüstenhagen (2010) indicates a positive effect of LCC information on the purchase likelihood of eco-innovations.

The employment of the LCC approach has been restricted for several reasons. Because LCC makes predictions about the unknown future and relies heavily on assumptions and subjective evaluations, conducting a reliable LCC analysis may be difficult (e.g., Korpi & Ala-Risku, 2008). Regarding this, Lindholm and Suomala (2005) indicated that one of the main barriers toward using LCC information as a decision support is its unreliability.



Gluch and Baumann (2004), in turn, highlighted that LCC does not consider the decision-maker's limited ability to make rational decisions in uncertain environment. Thus, it is essential to model the impact of various assumptions underlying an LCC exercise with methods such as a sensitivity analysis, scenarios, and simulation techniques (Ilg et al., 2017; Emblemstvag, 2001; Flanagan et al., 1987). Making uncertainty visible can clearly improve the usability of LCC as a decision-support method. On the other hand, Hochschorner (2011) indicated that the reasons for not using LCC are, for example, that it is complicated, time-consuming, expensive, and difficult because of the public purchasing rules. In addition, it has been argued that one reason for LCC not being effectively used is the short-term view of the management, which ignores the potential savings in the long run (Higham, 2015; Ahmed, 1995).

To summarize, the same idea underlies both the VfM and LCC approaches. In short, VfM and LCC guide decision-makers toward choices in which the long-term costs are balanced with the achieved benefits and encourage comprehensive and long-term thinking. It is important for decision-makers to identify the decision-making situations where these approaches are most beneficial. As there are numerous ways to pursue VfM (e.g., McKeivitt & Davis, 2016) and to practice LCC (e.g., Korpi & Ala-Risku, 2008), decision-makers should be able to select an appropriate method that does not exceed its value. Moreover, the information needs arising from the application of these kinds of methods should be noted in MA development in general.

## **2.3 Approaches to support supplier's business development**

Business development requires a number of decisions to be made and a variety of knowledge produced with the help of MA. In this thesis, the focus is especially on the actions the manufacturing companies are taking when moving toward providing services to industrial customers. First, MA can help to shape and guide organizational processes and actions (Hopwood, 1983). More precisely, MA could assess the efficiency with which organizational processes could deliver innovations to the market in cost-effective ways (Chenhall & Moers, 2015). On the other hand, MA plays a key role in companies' competitive positioning and in customer-profitability management (Holm et al., 2016).

Servitization can be defined, for example, as the innovation of an organization's capabilities and processes to shift from selling products to selling integrated products and services that deliver value in use (Baines et al., 2009). For companies selling industrial equipment, delivering services can be seen as a main strategic driver for ensuring long-term revenues and customer satisfaction (Cavalieri et al., 2007). Neely (2008) pointed out that to survive in global business, manufacturing companies have to move up the value chain and create integrated products and services, so they do not have to compete based only on equipment cost. In addition, a broad service portfolio has the potential to be unique and improve the ability to differentiate the total offering from competitors (Benedettini et al., 2017; Nordin & Kowalkowski, 2010). However, consensus about the

factors that drive manufacturers toward more service-oriented strategies has not been reached (Burton et al., 2017). In turn, even though a broad service portfolio yields several advantages, many companies have found it difficult to achieve the expected revenues, profits, and customer satisfaction through servitization (Benedettini et al., 2017; Kowalkowski et al., 2017).

A key to successful servitization is the realignment of the company's business model, organizational structure, and processes (Parida et al., 2014; Oliva & Kallenberg, 2003). A service business model means that the supplier commits to improving customers' value in use and thus assumes greater responsibility for the overall value-creating process as compared to product-centric, transaction-based business models (Kowalkowski et al., 2017). Burton et al. (2017) highlighted that in service business development it is crucial to take into account the delivery system, the technology, or operational processes used, and the customer interface. In turn, Huikkola et al. (2016) underlined that there is often a need for new capabilities and resources, the arranging of existing resources in new ways, and the release of resources that are no longer needed. As summarized by Johnson et al. (2008), when renewing the business model, it is important to first recognize the customer needs, then the possible ways to fulfill those needs, and finally to identify how to change the existing models to capture the new opportunities profitably.

In the context of service business development, there is a need to take a long-term perspective in managerial analysis and decision-making (Cohen & Whang, 1997). According to Laine et al. (2012), MA may be beneficial to the servitization process if the key business phenomena can be captured with the help of a set of relevant accounting objects. In practice, this may need a shift from traditional product- and service-level analysis to broader perspectives that consider external factors as well. Regarding this, Cavalieri et al. (2007) highlighted that performance indicators that guide after-sales business have to adopt a multidimensional approach, and capture effectiveness and efficiency, short-term and long-term, tangible and intangible, operational and strategic decision-making levels. Overall, MA practices form a central part of the information set from which inferences about the performance of organizations are formed (Hall, 2016).

Extending service sales requires market-oriented business development and companies should recognize the possibilities of generating revenues from an installed base of products with a long life-cycle (e.g., Gebauer et al., 2005). Kim et al. (2017) defined how the installed base of the product is the number of sold products that is in use and can lead to demand for spare parts. In turn, according to Oliva and Kallenberg (2003), the installed base is the total number of products in use and the installed base services are the range of product- or process-related services required over the life of a product. Manufacturers' capacity to analyze and interpret product usage and customer process data from an installed base enables them to develop service offerings that may allow customers to increase productivity or reduce costs (Ulaga & Reinartz, 2011). For example, Wagner and Lindemann (2008) pointed out that the knowledge of the installed base can help

companies in managing their spare part business. Thus, this thesis has examined approaches that combine MA and installed base information in the context of service business development.

Long-term customer relationships and the emphasis on the business model changes from transaction-to-relation-based are characteristics of servitization (Penttinen & Palmer, 2007; Oliva & Kallenberg, 2003). Thus, there is a need to capture the nature of the customer relationships with the MA analyses. According to Holm et al. (2016), measuring customer profitability can provide valuable information for management decisions regarding sales, marketing, and strategy. However, it has been indicated that customer management decisions are often based on a rule of thumb rather than on analytical approaches (Persson & Ryals, 2014). The focus in this thesis is on the possibilities to apply RFM analysis to customer-profitability management. The idea of RFM analysis is to divide customers into segments based on variables describing their past buying behavior (Verhoef et al., 2003). Visibility relating to customer-segment information may facilitate both short- and long-term decision-making at different organizational levels.

With regards to the idea of providing the best VfM for the customer, the service offering should be optimized from a life-cycle perspective and in relation to customer value (Sakao & Lindahl, 2015). In other words, instead of only delivering a great product, a supplier has to deliver a combination of services that minimize the overall costs associated with owning and using the product (Wise & Baumgartner, 1999). This enables manufacturing companies to capture business from the value chain throughout the entire product life-cycle (Aurich et al., 2010). Servitization leads to changes in suppliers' business models and in conceptions of ownership on the customer side. If the manufacturer retains ownership of the product and the customer is paying for access or performance, there is an incentive for the manufacturer to reduce operating costs (Spring & Araujo, 2017). From the customers' perspective, in turn, acquiring services offers a route toward reducing risk and decreasing, or at least making predictable, maintenance and support costs (Neely, 2008). In this context, Bettencourt and Brown (2013) argued that product-dominant manufacturing companies must recognize that services are solutions to customer needs and successful servitization requires a proper understanding of customer value. Thus, manufacturing companies should price their service offerings based on the customers' value-, rather than cost-based strategies (Rapaccini, 2015; Nordin & Kowalkowski, 2010).

MA provides methods and tools that can help to understand customer value and assist in formulating service contracts. It has been highlighted that a key issue regarding servitization is that the supplier's sales function could understand the financial business implications and the drivers of value for the customers (Kindström, 2010). Wouters and Kirchberger (2015) discussed that in order to understand which market offering provides the greatest value for customers, different criteria should be commensurable and expressed in monetary terms. To understand the long-term economic implications and to

develop service offerings, the literature has introduced different cost-modeling techniques such as LCC for service contracts (Bonetti et al., 2016; Kambanou & Lindahl, 2016; Sakao & Lindahl, 2015; Settanni et al., 2014; Datta & Roy, 2010). For example, providing availability-based contracts as an alternative to the purchase of an asset requires that manufacturers address the costs of servicing such products with the help of LCC or other similar approaches (Settanni et al., 2014). However, forecasting the costs and profits at the bidding stage of such contracts is challenging because of the complexity and uncertainty related to the product life-cycle (Erkoyuncu et al., 2014). Despite the challenges, companies can employ arguments based on the long-term economic evaluations when selling and pricing service offerings (Rabetino et al., 2015; Rapaccini, 2015).

A shift toward providing more services in manufacturing companies has brought new kinds of requirements for MA. Inevitably, the changes in business models reflect on the structure and use of MA in several ways. Thus, as pointed out by Chenhall and Moers (2015), development objectives require more innovative approaches to value creation than formal cost-management practices focusing, as conventionally conceived, on cost reduction. To exploit the business potential of servitization, new approaches to utilize MA together with other information may be needed. Overall, support from MA is required to enable sound business decisions to be made regarding organizational arrangements and new service offerings that may have long-term business consequences.



## 3 RESULTS

### 3.1 How can the customer's investment decision-making be supported with MA information

Articles I and II enabled us to answer the first research question of this thesis. In general, the idea of VfM to purchase goods and services that offer the best long-term price–quality ratio is a clear vision for investment decision-making. However, article I shows that there apparently are different views among different stakeholders on what VfM is. In addition, numerous possibilities to evaluate VfM based on substantive quality criteria exist. Moreover, because of the multidimensional and complex nature of public procurement, defining an absolute VfM is difficult. In particular, the affordability of an investment to a particular purchaser may differ from VfM for the public sector taken as a whole. Actually, it is extremely difficult to figure out objective and measurable quality criteria that reflect the long-term economic implications of investments. Thus, to overcome at least partly, the ambiguities related to pursuing VfM, there is a need to apply MA approaches such as LCC that can give structure to the expected impacts of complex investment cases.

LCC encourages taking a long-term outlook on investment decision-making and enables highly relevant cost scenarios of alternative technical solutions. By taking into account non-quantifiable attributes that are not initially expressed in monetary terms enables us to capture the comprehensive economic effects of investment decisions. Regarding this, by relying on LCC, it could be possible to justify the higher purchase price of sustainable products by embedding appropriate qualitative and environmental elements into the cost assessment. In addition, LCC helps us to consider the trade-offs between different elements and optimize the long-term performance of products. More particularly, constructing a long-term cost structure of a product enables us to highlight the most important life-cycle cost variables. Article II presented one way to model the uncertainties related to future assumptions and suggested that quantification of uncertainty is an essential feature of LCC.

Both articles I and II furthered knowledge on how LCC can provide investment decision-makers with a more comprehensive view on the long-term cost implications of alternative actions. To achieve the best VfM, LCC can be used as a planning tool in the early stages of the procurement process rather than as a tool for selecting the most suitable supplier or product at the bidding stage. For example, because the life-cycle costs of diverse waste-collection methods differ significantly, it is very important to assess the long-term economic effects of alternative technologies in the early planning phase. On the other hand, when the investment will lead to substantive operational costs for several decades,

it is better to study the overall economic feasibility of the investment at first. Actually, it could be difficult to argue about supplier selection based on LCC calculations since the differences between alternative products may be small compared with the uncertainty related to these estimates. In fact, one of the main barriers to using LCC information as decision support is the unreliability of the results. However, even modest-level LCC calculations may allow us to make a rough outline that can assist decision-makers in identifying the optimal investment alternative.

The nature of LCC and the methods applied evolve during the product life-cycle. In general, LCC is a potential tool for improving the organization's long-term cost consciousness. Article II proposes that organizations can learn about the behavior of product costs by practicing long-term cost management and collecting historical cost data. Actually, the systematic use of LCC may allow for the estimation of the effectiveness of certain technologies and can enable, for example, good timing regarding decisions on new investments. LCC may reveal important and even unexpected issues of the long-term cost structures for those who have a long history with the product. When different parts of the organization are responsible for the acquisition, utilization, and maintenance of products, the necessary cost and operational information might be fragmented within the organization and in different information systems. In that case, LCC is a suitable tool with which to collect the data that exists in different forms in the organization and thus enables an overall view of the situation.

Article II illustrates that carrying out LCC analysis is laborious because there is a need to gather a lot of information from different sources. Thus, it should be highlighted that the cost of pursuing VfM by conducting MEAT and LCC analyses must not exceed its value. As a result, for example, public procurers could choose and execute the appropriate contract-award method that is in line with both practical needs and available resources. Article I revealed that it is worth considering whether to use MEAT with qualitative criteria or pursue VfM by relying on appropriate quality requirements. Moreover, to evade the problem of valuing non-quantifiable criteria, it is possible to enter all the necessary qualitative requirements in tender specifications and award the contract based on price alone. On the other hand, proceeding with looser criteria and using the best price–quality criteria may lead to the assessment of diverse alternative solutions. As proposed in article I, an ideal solution to ensure VfM in investment decision-making is to include sufficient quality criterion and use MEAT in contract-awarding. However, it is essential to focus the organization's limited resources on MEAT and LCC regarding the most critical and significant purchase cases. Table 4 presents the key issues to be considered when developing MA to support investment decision-making.

**Table 4.** *Considerations for developing MA to support investment decision-making.*

<i>Challenges in using MA information</i>	<i>Characteristics of the effective use of MA</i>
Lack of awareness of the possibilities of MA	Recognizing the potential of MA in the planning stage
Fragmented MA information within the organization	Collecting diverse input data from different sources
Producing long-term MA information is laborious	Simplicity and usability of the MA approaches
Unreliability of the long-term MA information	Incorporating uncertainty into MA approaches

As summarized in Table 4, many challenges in using MA information exist. However, recognizing the characteristics for the effective use of MA may provide insights that will facilitate the development of MA. Overall, it is important to maintain the balance between the adequate examinations of the complex investment cases and the simplicity of the developed approaches.

### **3.2 How can the supplier's business development be supported with MA information?**

The second research question of this thesis is answered based on articles III and IV. Machinery manufacturers can facilitate decision-making related to business development with the help of MA practices and tools in several ways. MA can produce the necessary information for understanding the financial impacts of actions at different levels and from different viewpoints. In addition, MA produces information for selecting and prioritizing actions to be taken in business development. However, traditional MA practices may not provide sufficient information to support managerial decision-making. Thus, to provide enough support for decision-makers, there may be a need to process the MA data taken directly from the systems and combine them with other data or information.

The findings of article III suggest that especially in global companies, the development of service business is necessary to build on market area-specific MA information. Learning from differing local contexts may also require taking into account the equipment fleet and customer characteristics of different areas. In practice, it may be difficult to analyze the financial performance of different market areas and subunits based on data taken directly from the systems. Thus, MA enables the business to consolidate the scattered financial and non-financial data collected across different reporting lines and complex organizational structures. Due to the varying local MA practices and internal business transactions, the data may need to be further processed to best support the decision-making. To get a comprehensive view of the market-area characteristics, there is a need to also collect non-financial information concerning the local business practices, customers, and competitors.



Article III revealed that companies may focus too much on the profitability of specific areas of responsibility and developing the service business requires considering the overall profitability implications with the help of MA. In other words, MA may enable companies to examine how various parts of a business can better fit together to improve the company's overall and long-term profitability. In practice, that may require development of MA approaches that combine both financial and non-financial figures across business lines and units. For example, article II showed that the maintenance function could offer equipment modernizations at affordable prices with the assumption that this will lead to spare part sales in the future. Even though that is not an attractive strategy from the maintenance function's point of view, it can improve the company's overall profitability. However, the lines of responsibility within hierarchical organizational structures may restrict companies from choosing the most profitable ways of doing business. In that case, it is essential to rationalize the decision with the help of MA information.

Both articles III and IV suggested that manufacturing companies may encounter MA challenges when moving toward more service-based business models and may require new kinds of indicators for performance measurement and management. For example, it is important to explicitly acknowledge and monitor the link between equipment deliveries and their impact on service business. Article III showed that the interaction between product and service activities may not appear within routine financial reporting practices and thus a consolidation needs to be performed with MA. Traditionally, MA focuses on product- and service-level analysis but evaluating the profitability implications of service actions may require a broader approach to support the process of identifying and capturing the business potentials. Thus, the unit of analysis in MA may be the business line, business unit, a market area, a customer segment, or even the equipment fleet.

Articles III and IV demonstrated that knowledge of the equipment fleet could help manufacturing companies to assess the business potential of services and target their development actions. First, article III showed that just simply collecting and structuring the equipment-fleet data may reveal the characteristics of different market areas. Measuring the financial figures against equipment-fleet data can indicate the current level and future business potential of different market areas, business units, or customer segments. Based on that information, it could be possible to define indicators reflecting the market share and identify the undeployed potential of service activities in the global equipment fleet. More particularly, the equipment-fleet measures could provide insights into the type of actions and resources needed in different market areas. For example, if the company has quite a high market share and the market is mature, the strategic focus could be placed on capturing business from competitors' equipment. On the other hand, if the equipment fleet is growing and there seems to be exploitable business potential, a key issue is to reach the customers who have already bought equipment from the company.

To identify the supplier's economic opportunities in service businesses, there may be a need to capture the nature of new kinds of customer relationships and the potential lying within the diverse customer base by relying on diverse MA approaches. The measures reflecting customer segmentation can provide supportive data for decision-making regarding the channeling of sales activities. Article IV provided an idea that machinery manufacturers can segment their service business customers with the help of the RFM analysis that is common in business to consumer marketing. The RFM analysis evaluates customers based on (R) how recent their latest purchase has been, (F) how frequently the customers have made purchase, and (M) how high the monetary value of their purchases is. Combining the knowledge of the equipment fleet with the RFM analysis enables the business to understand which customers are particularly interesting for service sales and why. Together, the traditional RFM analysis and fleet characteristics can reveal the service business potential and sort customers into meaningful segments. Based on the analysis, companies can both examine the long-term economic implications of service activities and focus their daily service sales resources on the segments where they could be most impactful.

The insight that the purchase-price proportion of the product's total life-cycle costs may be small can be seen as a driver for new kinds of business models in supplier organizations. When suppliers offer complex service solutions to their customers, there is a need to develop MA practices and performance indicators that can provide a comprehensive understanding of the economic impacts of different business models. For example, by relying on LCC, suppliers can turn future maintenance procedures into monetary terms through the consumption of spare parts, and the need for upgrades. Actually, one aspect of suppliers' MA development can be the issue of how to optimize the service offering in relation to customer value. Suppliers may develop MA practices and tools that can facilitate their customers' understanding of the value of new service solutions and make the product's long-term cost implications visible to customers. That kind of MA information can be exploited in the negotiations with customers and in the development of product and service portfolios.

To summarize, MA and approaches such as LCC can assist suppliers to find possible pathways to develop service businesses and provide the means with which to communicate with customers. Actually, article I provided ideas on how the supplier could enhance the customers' knowledge that is needed for effective long-term decision-making. More precisely, the aim was to provide customers with information on the life-cycle cost implications and the product's qualitative issues. Overall, there are many challenges in using MA information for decision support in the context of business development (Table 5).

**Table 5.** *Considerations for developing MA to support business development.*

<i>Challenges in using MA information</i>	<i>Characteristics for the effective use of MA</i>
The focus on separate product- and service-level analysis	Re-thinking the unit of analysis in MA
The focus on certain areas of responsibility	Enabling a view across organizational functions
MA does not capture the total profitability implications	Enabling a long-term view on costs and profits
A narrow view of traditional MA practices	Combining MA and other information

As presented in Table 5, traditional MA practices may provide a narrow view of the total and long-term profitability implications of business development actions. Thus, re-thinking of the unit of analysis in MA and combining MA and other information may provide new insights that can support management and business development actions.

### **3.3 What kinds of characteristics are desired for MA development to support long-term decision-making?**

All the articles together provide an answer to the third research question of this thesis. Through the specific MA development cases, it is possible to discuss the characteristics of MA development on a more general level. It seems that within the traditional MA frameworks it may be difficult to get a comprehensive understanding of the decision situation at hand. More particularly, article II indicated that it could be that no one in the customer organization has visibility in terms of the overall cost implications of investment decisions. Instead, the cost and operational information related to procurement, maintenance, and usage might be scattered in different forms across different parts of the organization. Consequently, decision-makers lack coherent MA information and the long-term cost consciousness might be on a weak level. Thus, a key characteristic for MA development is that the approaches and tools could be able to collect and consolidate the diverse data across organizational units. In addition, depending on the accounting object, there may be a need to incorporate the elements of uncertainty into MA approaches aiming to support long-term decision-making.

In turn, article III showed that the current MA frameworks may not support business development actions either. Different intra-organizational needs and MA practices may restrict the development of business in a way that could be most effective and profitable at the company level. In particular, article III provided empirical evidence that looking at the business's separate units together with the help of MA information may reveal the most profitable business models. For example, the supplier figured out that when the maintenance function offered equipment modernizations at a reasonable price, the company managed to acquire new customers who would later buy specialized spare parts from the company. Hence, the possibility of generating cross-organizational views may

be necessary to take into account in MA development. Suppliers' comprehensive thinking ability acquired through MA information supports long-term decision-making and may lead to better product and service offerings.

MA development may require expertise and knowledge from different parts of the organization and co-operation between customers and suppliers. Article I showed that implementing MA approaches such as LCC into public procurement requires new skills from individuals who are working with tenders both in customer and supplier organizations. All the articles provided further empirical evidence that to exercise and develop MA practices such as LCC, cooperation between organizational units is needed. In addition to pure MA data, LCC requires information, for example, related to operational processes. Actually, the MA development work in all of the research projects underlying this thesis was carried out outside the financial functions of the case organizations. The role of traditional accounts was only to provide the basic MA information for the projects. In particular, article II showed that supporting methods associated with LCC may not be found inside the boundaries of MA. For example, there was a need for a product-utilization plan, and thus the maintenance function of the case organization was deeply involved with the LCC development project. Articles III and IV indicated, in turn, that representatives of the spare part and maintenance functions may play a key role when developing MA for service business development. The desired characteristics for MA development emerging from this thesis are summarized in Table 6.

**Table 6.** *Considerations for developing MA to support long-term decision-making.*

<b><i>Desired characteristics for MA development</i></b>
Need to collect and consolidate scattered and diverse data across organizational units and different systems
Need for expertise and knowledge from different parts of the organization
Need for co-operation between customers and suppliers
Need for supporting methods outside the boundaries of MA

As indicated in Table 6, using the methods outside the traditional MA practices may require knowledge from different organizational fields and new ways in which to combine information collected across several systems. Overall, the results suggest that diverse combinations of data and expertise are needed in MA development to facilitate long-term decision-making.



## 4 CONCLUSIONS

### 4.1 Discussion of the results

This thesis responds to the identified need for MA information to support managerial work and decision making (Hall, 2010; Wouters & Verdaasdonk, 2002). *Firstly*, the main contribution of this thesis is in showing that MA can increase the likelihood of good decisions simply by structuring the long-term decision effects in monetary terms and integrating knowledge into meaningful insights. For example, the thesis suggests that MA information about existing, rather traditional service business could serve also the purpose of partially understanding customer behavior, and thus support new service business development in this context. Although literature has emphasized the accuracy of MA information (e.g., Pizzini, 2006) and the detail of LCC analysis (e.g., El-Akruti et al. 2016), this thesis proposes that even by roughly outlining the phenomenon at hand with the help of MA information about multiple viewpoints regarding the long-term business impacts can be very helpful for decision-makers. Overall, the studies underlying this thesis suggest that there is a need to achieve a balance between accuracy and simplicity when developing MA approaches. Based on this thesis, finding such a balance requires careful examination of the decision-making situation.

This thesis deepens the understanding of knowledge integration in MA (Laine et al., 2016; Wouters & Roijmans, 2011) by presenting new approaches through its specific MA development cases. In line with previous studies (e.g., Laine et al., 2016; Rantamaa et al., 2015), this thesis proposes that MA can frame the new decision situations by integrating knowledge from different functions. Traditional MA practices such as monthly financial reporting may provide a narrow view of total cost and profitability implications of the new businesses since the focus of the reporting is typically limited to existing product- and service-level analyses. Thus, there is a need to develop approaches that can provide comprehensive MA information and encourage decision-makers to move toward long-term thinking. However, the findings of this thesis suggest that current MA reports and frameworks do not adequately reflect the diverse consequences of decisions and facilitate the discussion over complex investments and business development actions. Thus, to provide a proper basis for complex decisions, constructing MA information requires knowledge integration from different operational processes, functions, and information systems (see e.g., Wouters & Roijmans, 2011). In the next paragraphs, the contributions of the thesis for using VfM and LCC for decision-making, and for supporting servitization with the help of MA information will be further elaborated.

*Secondly*, the thesis contributes to the existing understanding about using VfM and LCC for decision-making in public and private organizations. The findings of this thesis strengthened the previous understanding (Barrett, 2016; MacDonald et al., 2012;

Glendinning, 1988) that defining the absolute VfM (as a ratio, for example) may be a difficult and even impossible task because people assess the monetary value of things differently. Even though different stakeholders may have diverse perceptions of what VfM is (Barrett, 2016), approaches such as LCC can assist complex investment cases by structuring the expected long-term economic impacts of decision alternatives. In this vein, as a unique contribution, this thesis complements the notion of Chenhall and Moers (2015) that practices such as LCC provide approaches that focus on how contemporary accounting can be used as organizing rationales. The potential of LCC for supporting decision-making is also suggested by the study by Butler and Ghosh (2015) indicating that decision aid (such as LCC tool or report) can induce a decision-maker with a low comprehensive thinking ability to act like one with a high ability. In addition, it has been noted that the form of information may influence the complexity of the decision problem (Deutsch, 2010) and thus it is important to provide decision-makers with structured information with the help of MA approaches such as LCC.

More particularly, this thesis suggests that the potential of MA approaches such as LCC as a decision aid is greatest in the early planning stage. This argument corresponds to the observation that the initial choice of project concept is of critical importance and is likely to have the largest impact on long-term success or failure (Williams & Samset, 2010). Regarding this, it has been argued that the selections done in the pre-tendering phase of the public-procurement process offer the highest potential to achieve the best VfM (McKevitt & Davis, 2016; Dimitri, 2013). Clearly, the possibility of affecting the life-cycle effects is greatest in the early stages but the uncertainty related to evaluations, in turn, is at the highest level (Samset & Christensen, 2017). However, the findings of this thesis suggest that even though the information provided by LCC may be unambiguous and rough in the early planning stage, it can present the expected impacts of complex investments in a structured form and enable the comparison of alternatives.

Despite the ambiguity and incompleteness of the figures, MA presents financial matters as shared and collective and thus organizational members can draw from them (Farjaudon & Morales, 2013; Ahrens & Chapman, 2007). Moreover, for example, Laine et al. (2017) discussed that despite the difficulties related to calculating the environmental costs, accounting provides powerful devices that can be used to point resources and organization activities in particular directions. It is noticeable that depending on the stakeholder, the aim and interest to perform LCC can diverge largely and have an impact on the choice of method (Kovacic & Zoller, 2015). The study by Ilg et al. (2016), for example, demonstrated that once the boundaries of LCC are extended to a more eco-centric view, the result of LCC changes significantly compared to conventional LCC. Thus, this thesis suggests that it is essential to be able select an appropriate MA approach for the given decision situation depending on the nature of the accounting object and available resources.

The findings of this thesis support previous literature (Samset & Christensen, 2017) that regarding public investment projects, economic evaluation and its utilization is not objective or unambiguous but rather a political and administrative process. However, in addition to strategic and political objectives such as welfare and sustainability, decisions are often made to allow cost savings (Uyarra & Flanagan, 2010) and thus MA can contribute to the achievement of VfM through the entire public-procurement process. Even the MA practices are not neutral to power and politics, the use of MA may be important when identifying the needs for and gaining others support for changes (Hiebl, 2017). In public procurement, there may be a conflict of aims between policy makers and those whom they serve because of the different short-term and long-term interests (Glendinning, 1988). Thus, it could be that non-economic policy considerations dominate the decision-making, which discourages efforts to make laborious LCC analyses during the decision process. Indeed, the findings of this thesis support previous studies (Tagesson et al., 2015) indicating that, to avoid subjective assessments of qualitative issues and to reduce the risk of appeals, the price could be the predominant factor in public-procurement decision-making. On the other hand, Lindholm and Suomala (2005) figured out that price is often the most important factor affecting the purchasing decision in the private sector even if it is well known that the life-cycle costs could substantially exceed the initial purchase price. Actually, the importance of subjective factors in managements' decision-making explains, at least in part, why LCC principles are not effectively applied (Goh & Sun, 2016).

*Thirdly*, this thesis contributes to the servitization literature by identifying needs for MA development in the context of manufacturing companies moving toward more service-based business models. For example, Chenhall and Moers (2015) indicated that MA should be consistent with structural arrangements that aim to support efforts for coordination and integration between the various decision-making segments within the organization. However, as this thesis suggests, MA practices, especially in global companies, are often complex activities, and tend to require development to more comprehensively capture how various parts of a business would better fit together to improve a company's overall profitability. By relying on MA approaches, it would be possible for the machinery manufacturers to make the overall profitability implications visible for different stakeholders and to rationalize the business development decisions. This suggestion is supported by the observation that accounting devices could change organizational and institutional logics by introducing new appreciations and perceptions that appear neutral and technical (Farjaudon & Morales, 2013).

The findings of this thesis elaborate on the servitization literature (Kastalli & Van Looy, 2013; Gebauer et al., 2005; Oliva & Kallenberg, 2003) by emphasizing the need for the explicit linkage between equipment and service operations in providing MA information for service business development. In particular, if the interaction between equipment and service activities does not appear within traditional financial reporting, the scattered



financial data could be consolidated with the help of new MA information. By building on Wouters and Verdaasdonk (2002), this thesis suggests that producing MA information for decision support requires combining information from various sources and may involve making trade-offs. This is supported by Jorge et al. (2017), indicating that integrated MA information is not only about supporting decision-making, but that it provides a basis for coordination and cooperation between organizational units.

More particularly, as a contribution to prior literature, this thesis adds to the studies by Rabetino et al. (2017), Dekker et al. (2013), Holmström et al. (2010), and Wagner and Lindemann (2008) by presenting new ways of combining MA and equipment-fleet information. More precisely, companies are proposed to develop measures that reflect the service business potential stemming from the equipment fleet. Thus, this thesis relies on the idea that a large installed base of products makes economic sense to the manufacturer of the original equipment to offer life-cycle support and services (Neely, 2008; Wise & Baumgartner, 1999). In line with this, Spring and Araujo (2017) pointed out that typically the product and the life-cycle that is sets in motion is treated as a stable backdrop against which the offer of various service elements can be configured. Moreover, this thesis contributes to the literature by illustrating that RFM customer-segmentation analysis, typically adopted in the B2C context, can support decision-making regarding machinery-manufacturers' service business development. In particular, new knowledge on combining equipment-fleet characteristics with the RFM analysis was presented in this thesis.

This thesis argues that to identify profitable service solutions and to develop valuable offerings to customers there is a need for comprehensive MA information produced with tools such as LCC (see e.g., Rabetino et al., 2015; Sakao & Lindahl, 2015; Garetti et al., 2012). In line with the literature (Sakao & Lindahl, 2015; Garetti et al., 2012), this thesis suggests that service offerings should be optimized from a life-cycle perspective with the help of MA information. Moreover, MA may help customers to recognize the value of new products and services (Wouters & Kirchberger, 2015). In particular, this means that suppliers can employ arguments generated based on the idea of LCC when selling and pricing life-cycle service offerings (Rabetino et al., 2015). On the other hand, in some industries, suppliers are used to providing LCC information to customers in the purchase phase and there may even be penalties related to the life-cycle cost overrun (Lindholm & Suomala, 2005). In that sense, developing MA in a way that corresponds to customer needs and the management of complex service solutions is crucial for both the customers and suppliers.

It has been highlighted in this thesis that both the customer and supplier perspectives should be taken into account when developing MA to support service businesses, and servitization initiatives. For example, according to Dunk (2004), LCC may be seen as a customer service since it allows examining existing product characteristics and the changes required to better meet the customers' product expectations. Suppliers'

possibilities to utilize historically collected LCC data depend on the information they obtain from customers and thus co-operation in LCC between suppliers and customers has been seen as important among industrial companies (Lindholm & Suomala, 2005). Actually, collaboration between customers and suppliers can lead to new product ideas and service offerings that may increase value for customers (Nordin, 2008) and thus have an effect on the pricing strategies (Rapaccini, 2015; Nordin & Kowalkowski, 2010). For customers, it is essential to get information from suppliers regarding alternative solutions and their economic implications (Wouters & Kirchberger, 2015).

*Finally*, regarding the multidimensional needs related to MA development, the findings of this thesis complement the literature that has recognized the existence of hybrid management accounting (Hyvönen et al., 2009; Byrne & Pierce, 2007; Kurunmäki, 2004). In particular, implementing MA techniques such as LCC and customer-profitability analysis may enhance the business orientation of the management accounting function (Järvenpää, 2007). On the other hand, the findings of this thesis support the notion that organization structures can restrict the adoption of LCC because different departments are making decisions in isolation of each other (Cole & Sterner, 2000). Thus, this thesis proposes that MA should be developed to more comprehensively capture the overall business impacts of development actions and to reduce sub-optimization between organizational units. Overall, MA information can clarify and change the ways of thinking, which may lead to more efficient and profitable business operations.

## **4.2 Managerial implications**

This thesis underlines the importance of understanding the comprehensive economic effects of managerial decision-making in both the investment and business development contexts. The findings illustrate that MA can provide valuable information for decision support, especially when data are structured and processed into a suitable format. Even though the findings are based on in-depth case studies, the main ideas are applicable in other types of environments as well. Regarding MA development, this thesis recommends practitioners take advantage of LCC in the early stages of the procurement process. This is because the chance of affecting the life-cycle effects is greatest in the early planning phase. For example, regarding waste collection, the costs related to through-life operational costs depend on the selected waste-collection method. After the technology selection, the differences in life-cycle costs of alternative products may be small and it is not worth the money by using LCC as a basis for supplier selection. This thesis has highlighted a number of problem areas in pursuing VfM with methods such as LCC. However, various strategies or means are available for managers to integrate quality aspects into procurement and achieve VfM. In particular, this thesis suggests managers carefully consider whether to use qualitative contract-award criteria or to simply rely on using appropriate quality requirements in tendering.

It has been highlighted in this thesis that servitization creates a need for both customers and suppliers to get to know the TCO of a product. Thus, managers in both customer and supplier organizations can utilize the LCC approach in business development contexts. On the other hand, this thesis illustrates that an extensive and detailed implementation of LCC may lead to diversified and laborious analyses. However, this thesis suggests that managers developing their MA practices could adopt a much simpler approach and examine, for example, only the operational costs of a product from the customer organization's point of view. It has been proposed in this thesis that even a modest LCC model can help managers to collect and present information to stakeholders in a structured form. Even though the LCC information may be unambiguous, it can present the expected impacts of complex investments in monetary units and enable the comparison of alternatives. This could help managerial decision-making by revealing the long-term cost structure of a product and causalities between the different cost elements.

Regarding machinery-manufacturers' service business development, this thesis provides insights into how to get a comprehensive understanding of the service business potential with the help of MA. This thesis argues that it is not possible to capture all the aspects needed to support service business development within traditional financial reporting that typically focuses on product- and service-level analysis. Thus, there may be a need to develop MA approaches that enable gathering and presenting data on the combinations of different product and service categories. In addition, it may be necessary to combine MA and other information such as data on customers and the equipment fleet. Especially, this thesis suggests that the characteristics of equipment fleets could be considered when developing service business in different market areas. More precisely, machinery manufacturers could, for example, define performance measures reflecting the business potential stemming from the equipment fleet. For example, it is possible to measure service business sales against fleet size in different market areas and use that information in seeking avenues for development. In practice, this may require the consolidation of data collected across different financial reporting lines and from different information systems.

This thesis highlights that managers of global machinery manufacturers should take into account the overall profitability implications of development actions rather than simply focusing on their own areas of responsibility. It is important for managers of different organizational units to develop service solutions together in order to avoid sub-optimization and, on the other hand, to create better services for their customers. Regarding spare part businesses, this thesis demonstrated that RFM analysis, often used in the B2C context, is an applicable approach for management of B2B sales as well. In particular, RFM analysis can support managers both in the sales frontline and in the back office. Finally, this thesis pointed out that developing comprehensive MA approaches requires competencies from different organizational areas, which is an issue that needs to be addressed by managers.

### 4.3 Assessment of the research

Internal validity stands for accurate descriptions of the relevant phases of research, meaning whether it is possible to draw valid conclusions from a study (Eisenhardt, 1989). External validity, in turn, refers to generalizability to theory and practice (Maxwell, 1992). Reliability means that the operations and procedures of the research inquiry can be repeated by other researchers who then achieve similar findings (McKinnon, 1988). However, it has been highlighted that in qualitative research, reliability and validity cannot be sensibly distinguished between and their dimensions are blurred (Ahrens & Chapman, 2006; Sinkovics et al., 2008). Actually, Maxwell (1992) indicated that there are no explicit ways to conceptualize validity issues in qualitative research. Regarding this, Lukka and Modell (2010) argued that in qualitative MA research, it is not clear how the validity of explanations can be established.

Threats to the validity of qualitative research during data collection are, for example, observer bias, data-access limitations, and the complexities of the human mind (Ihantola & Kihn, 2011). Observer bias means that the researcher's own values, projections, and expectations may affect to the data collection of behaviors and words (McKinnon, 1988). Thus, to enhance validity, researchers need to try to refrain from subjective judgements during the research design and data-collection phases (Riege, 2003). To minimize researcher bias, the author planned the research setting, interventions, and data collection of the studies underlying this thesis together with other researchers. In addition, McKinnon (1988) pointed out that seeking interpretations and meanings in too short a time increases the opportunity for researcher bias because too little data may lead to interpretation gaps that are closed due to the researcher's own values and expectations. In all, relying on different methods and multiple sources of evidence in the data-collection phase have reduced the effects of researcher bias in this thesis.

The aim of qualitative research is to achieve credible accounts and interpretations of organizational and MA processes (Parker, 2012). According to Sinkovics et al. (2008), the ultimate issue of validity in qualitative research is that there is evidence and logic in the data, which describes clearly how the interpretations were made. As pointed out by Flyvbjerg (2006), case studies often contain a substantial element of narrative, which approaches the complexities of real life, and the story itself is the result of the study. Actually, an important characteristic of a successful qualitative case study is that the story makes a credible impression on the reader (Lukka & Modell, 2010). Thus, there is a need to assess whether the accounts are convincing in the sense of being authentic, plausible, and convincingly drawn (Parker, 2012). In addition, researchers need to demonstrate that the interpretations drawn from data originate outside the researcher's own imagination (Sinkovics et al., 2008).

As the field researcher's prior knowledge and theoretical interest disciplines the interpretations of new observations (Ahrens & Chapman, 2006), a lack of alternative

interpretations of the data may threaten validity of the study. Thus, to increase the validity of the studies, the data have been analyzed, interpreted, and reflected upon by several researchers. Actually, appropriately organized field notes and recordings have allowed for a return to the data when needed. As the realities can be interpreted in multiple ways, the data analyses and interventions were discussed and developed with the key informants on a regular basis during the studies. Overall, the interventionist approach and close relationships to the case organizations enabled authentic descriptions of the phenomenon to be created in real-life contexts. Even though case studies allow room for the researcher's subjective judgements, the advantage is that they can test real-life views of practitioners in relation to phenomena (Flyvbjerg, 2006). Thus, regarding this thesis, to get an in-depth understanding of the complex phenomenon may not have been possible using a quantitative research approach. However, as highlighted by Lukka and Modell (2010), interpretive MA research can produce explanations from an external viewpoint by analyzing the actual events in a specific context and the interpretations are more than just individuals' subjective understandings.

The generalizability of qualitative research is concerned with whether the research results can be transferred and extended to a wider context (Ihantola & Kihn, 2011). However, qualitative studies are usually not designed to allow for the systematic generalization of the findings (Maxwell, 1992). In turn, a detailed examination of a single example can provide reliable information in a broader sense (Flyvbjerg, 2006). In line with this, the aim of the studies underlying this thesis was not to create or test theories and to generalize the findings in a broad sense but to get an in-depth understanding of the phenomenon. One threat to the transferability of a qualitative study may occur if the empirical findings are not reflected in previous studies and in theoretical contributions (Ihantola & Kihn, 2011). The validity of the research has been verified by carefully comparing the evidence with the existing literature and by clearly outlining the theoretical and managerial implications of the studies.

Reliability refers to the repeatability and accuracy of research findings (McKinnon, 1988). In qualitative research, procedural reliability means that the researcher has adopted appropriate research methods and procedures and that this has been demonstrated (Kihn & Ihantola, 2015). Thus, procedural reliability can be ensured by careful data collection, data classification, interpretation, and the development of links to theory (McKinnon, 1988). Regarding this thesis, the cases have been described thoroughly in the original publications, which enhances the reliability of the studies significantly. However, because in interventionist approaches, the researcher's personal involvement and the characteristics of the case companies shape the research process, it is unlikely that exactly the same results can be achieved by other researchers. Overall, for example, Parker (2012) highlighted that the identification of the uniqueness in qualitative MA research is central, while not rejecting notions of the replicability of the research.

The underlying issue regarding reliability in qualitative research is whether the procedures or techniques used in the study process are consistent (Riege, 2003). Actually, Kihn and Ihantola (2015) highlighted that in interpretive studies of MA, validation is an ongoing process and requires accurate descriptions of the methodological phases. Regarding this thesis, the reliability of the studies is increased by using multiple researchers during the whole research processes. In practice, researchers with different backgrounds and expertise enabled the most appropriate methodological choices to be made. In addition, the substantial length of time in the research field made it possible to use multiple methods and observations in all the studies underlying this thesis.

#### **4.4 Limitations and further research**

Despite several theoretical and practical contributions, this thesis is subject to some limitations. First, the interventionist research approach limits the generalization of the findings since the case studies are likely to be unique. It should be noted that a case study, which is, to a great extent, based on the analysis of a particular product or a particular business, cannot provide solutions that are directly applicable to another case environment. More precisely, regarding all the studies, only a single real-life problem in a specific research setting was solved. However, the main ideas and characteristics of the created MA tools are likely to be useful for other organizations and industry fields. Despite this, the case organizations in which the interventionist studies were conducted definitely shaped the results and contributions of this study.

Regarding all the studies underlying this thesis, the research was limited to one in-depth case environment and thus somewhat different findings might have been reached in other case contexts. In general, to enhance the generalizability of the findings, further studies could gain evidence from more cases across different sectors. More specifically, article I proposes that to achieve generalized findings regarding the tender selection methods used in public procurement, more quantitative research based on large datasets is needed. In turn, the LCC modeling principles and cost-management framework presented in article II may be applicable to some other case settings without major adjustments. Hence, further research could test the applicability of the ideas in other case environments. Article III provided preliminary ideas for new kinds of performance measures utilizing MA and equipment-fleet information. Thus, further validation of the suggested measurement practices is needed and may be undertaken in the future. In addition, further research could test the utility of the RFM model presented in article IV in other case environments.

By building on the findings of this thesis, a couple of suggestions for future research are noteworthy. Drawing from the findings from article I, further research could consider the exploitation of LCC in tender selection. In particular, it would be essential to gain an understanding of the processes through which LCC is practiced and the persons involved in the process. Inspired by the findings from article III, it would be necessary to figure

out if servitization has led to changes in machinery-manufacturers' MA practices and in what way those changes have appeared in real-life contexts. Following the ideas presented in the literature review of this thesis, further research could consider how to exploit LCC in service business development. More precisely, it would be interesting to study how suppliers could promote their product and service offerings with the help of MA and especially with LCC information. Further, it could be possible to investigate the form of information that is most attractive and impactful for customers.

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## **PART II: THE ORIGINAL ARTICLES**



## **ARTICLE I**

Lindholm, A., Korhonen, T., Laine, T. & Suomala, P.

Engaging economic facts and valuations underlying VfM in public procurement

*Public Money & Management*

(accepted for publication)





# Engaging the economic facts and valuations underlying value for money in public procurement

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*This paper examines the possibilities and limitations in pursuing value for money (VfM) in public procurement. There is ambiguity about the VfM concept and the methods that public procurers should be using. It is difficult for decision-makers to thoroughly understand the economic facts and valuations underlying VfM. The authors explain the conceptual VfM challenges and present a path to overcoming these with a lifecycle costing (LCC) approach in an indepth case study in the Finnish waste management context.*

**Keywords:** Lifecycle costing; public procurement; value for money; waste management.

## Introduction

To serve the common good, the objective of public procurement should support the idea of the purchasing of goods and services that generate the greatest value for money (VfM) (McKevitt and Davis, 2016). In practice, this means awarding a public contract to the tenderer offering the best price–quality ratio, as opposed to awards based on the lowest price (Dimitri, 2013; Kiiver and Kodym, 2015). Because ‘value’ includes dimensions beyond the conventional economic perspective (for example social and environmental objectives plus intangible deliverables), there is a lack of consistency in the definition of VfM (MacDonald *et al.*, 2012; McKevitt, 2015). In addition, the perception of VfM for the same product or service may change over time due to, for example, new technologies or changes in environmental values. In the legal context of public procurement, to achieve the best VfM, the award of public contracts should be based on the principle of the most economically advantageous tender (MEAT) (Directive 2014/24/EU). Thus, in addition to price, contracting authorities can take into account criteria that reflect qualitative, environmental, and societal aspects when reaching an award decision.

Current academic knowledge does not yet adequately cover the practice of VfM management, although several studies have addressed the ambiguity of the VfM concept (McKevitt and Davis, 2016; Prowle *et al.*, 2016). It has been widely recognized that combining qualitative, social, and environmental aspects

in economic evaluations is not simple and may be a politically sensitive issue (Barrett, 2016; McKevitt and Davis, 2016). Consequently, economic facts and subjective valuations can be contradictory, misaligned, and problematic (for example Khadaroo, 2008; Lahdenperä, 2013). In turn, there is substantial research on tender evaluation models (Bergman and Lundberg, 2013; Dimitri, 2013; Kiiver and Kodym, 2015). However, little attention has been given to the methods supporting the early stages of the procurement process, even though the pre-tender phase offers the maximum potential for VfM (McKevitt and Davis, 2016). Cost management approaches, such as lifecycle costing (LCC), may help decision-makers to assess VfM. Overall, there is a need for a more solid understanding about how LCC and quality aspects can be integrated into public procurement procedures to actually gain VfM.

To address these challenges, this paper responds to the following research question:

*How can public procurement procedures engage economic facts and subjective valuations in order to achieve the best VfM?*

The paper takes advantage of an indepth case study (Yin, 1981; Eisenhardt and Graebner, 2007) at a Finnish company providing waste containers—called ‘WasteCo’ in this paper. The researchers were actively involved in the development activities aiming at enhancing public procurers’ understanding of qualitative issues and a lifecycle perspective. The indepth

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data based on this case was then supported by wider public tendering data available in Finland (the 'HILMA' portal). Altogether, five tender calls in the particular case study industry and 40 tenders across industries were analysed.

An important contribution of the paper is the identification of the possibilities and limitations in pursuing VfM in public procurement procedures. More particularly, the paper presents a detailed description of VfM challenges and a path toward overcoming these challenges in a real-life case.

### Literature review

#### *The supportive role of cost management in seeking VfM*

Within the field of cost management, several approaches can support the achievement of VfM. Pursuing VfM requires careful procurement planning, tender designing, and contract awarding (Dimitri, 2013). There is also a need for managers to ensure VfM realization in the post-tender phase through long-term evaluation of the actual and anticipated results (Khadaroo, 2008). In all of these stages, accounting information can support managerial work in decision-making and developing an understanding of the operational environment (Hall, 2010). As highlighted by Van den Abbeele *et al.* (2009), purchasers should identify the management accounting tools that might contribute to their organization's success.

In the absence of conceptual clarity, the meaning of VfM can be described with reference to other concepts, such as total cost of ownership (TCO) (McKevitt and Davis, 2016). Both TCO and LCC are approaches that focus on total costs rather than simply on price (Woodward, 1997). In this context, MacDonald *et al.* (2012) pointed out that the more sophisticated approaches to VfM look at the whole lifecycle rather than just the initial acquisition costs. Methods such as LCC and TCO quantify the costs of the activities involved in acquiring and using purchased goods or services (Asiedu and Gu, 1998; Van den Abbeele *et al.*, 2009). Further, Morssinkhof *et al.* (2011) emphasized that these methods can support purchasing decision-makers through the monetary quantification and aggregation of non-financial attributes.

The main idea behind LCC is to encourage a long-term outlook to an investment, rather than attempting to save money in the short term by procuring assets simply with a lower initial purchase cost (Woodward, 1997). Typical cost elements considered in LCC are related to the acquisition, usage, maintenance, and

disposal of an item (Asiedu and Gu, 1998). However, it is also possible to include factors related to environmental and societal aspects that are not objectively measurable (Martinez-Sanchez *et al.*, 2015). In all, LCC can be seen more as a way of thinking than merely as a costing tool, and it can support decision-makers in different stages of public procurement processes.

First, it is possible to utilize LCC when making decisions on what and how to procure. Ally and Pryor (2016) found that LCC is an ideal tool to produce cost scenarios for competing technologies and that it can provide decision-makers with a comprehensive set of economic information. According to McKevitt and Davis (2016), the potential for VfM to emerge begins with a goal, deciding on the trade-off between quality versus cost and then communicating these criteria to suppliers in concrete terms. In this context, Tarantini *et al.* (2011) noted that a lifecycle approach can support the development and definition of environmental criteria used within procurement procedures.

#### *Evaluating VfM in the legal context*

The difference between private purchases and public procurement is that while private customers can make their choices intuitively, public authorities must seek to objectivize their assessment in order to justify their award decision (Kiiver and Kodym, 2015). In the legal context, VfM is evaluated by relying on MEAT. The EU directive on public procurement (Directive 2014/24/EU) states that:

*MEAT from the point of view of the contracting authority shall be identified on the basis of the price or cost, using a cost-effectiveness approach, such as lifecycle costing and may include the best price-quality ratio, which shall be assessed on the basis of criteria, including qualitative, environmental and/or social aspects, linked to the subject-matter of the public contract in question.*

To determine which tender offers the best VfM, formulae that combine both price and quality criteria are used (Bergman and Lundberg, 2013; Kiiver and Kodym, 2015). Usually, there is a need to assign points to different monetary and non-monetary criteria that are expressed in different units of measurement (Dimitri, 2013). Some quality criteria may be non-quantifiable and assigning points for those could be contentious. Bröchner *et al.* (2016) indicated that, for example,

tenderers in the healthcare sector have to describe how they are going to achieve ‘meaningful everyday experience’ or similar vague concepts, on the basis of which officials or expert readers will grade the texts. This example illustrates that considering non-quantifiable award criteria in an objective and reproducible way is inevitably a challenge for contracting authorities.

One of the novelties of EU procurement regulations is the concept of LCC and the possibility of using the result of LCC as an award criteria (Directive 2014/24/EU). It is reasonable to award the contract based on lifecycle costs, for example, if the products or services differ in terms of energy consumption and maintenance costs (Ally and Pryor, 2016). In turn, the monetary value of environmental externalities linked to the product can be determined with the help of LCC (Reich, 2005). Martinez-Sanchez *et al.* (2015) argued that, by relying on LCC, contracting authorities have more flexibility to consider qualitative, environmental, and social aspects. It has been suggested that LCC can be used to justify the often higher purchase price of sustainable products by embedding appropriate elements into the cost assessment (Erridge and McIlroy, 2002). An interesting statement in the preliminary notes of Directive 2014/24/EU (89) is:

*The notion of award criteria is central to this Directive. It is therefore important that the relevant provisions be presented in as simple and streamlined a way as possible. This can be obtained by using the terminology ‘most economically advantageous tender’ as the over-riding concept, since all winning tenders should finally be chosen in accordance with what the individual contracting authority considers to be the economically best solution among those offered.*

For example, Watt *et al.* (2009) point out that the choice of one contractor over another is largely dependent on the purchaser’s preferences in terms of the evaluation criteria and weightings used, and the trade-offs they are willing to make. So even though the principles for tender selection are strictly regulated, they give the contracting authorities substantial freedom in choosing what qualifications and award criteria to use.

### **Challenges in engaging facts and subjective valuations in decision-making**

Complying with a non-quantifiable and subjective MEAT criterion may lead to a

complicated set-up in VfM evaluations. According to Lahdenperä (2013), it is challenging when public bodies are required to treat tenderers equally and act in a transparent way. For example, Falagario *et al.* (2012) stated that the definition of weights without any subjective setting by public authorities might be difficult. According to Bergman and Lundberg (2013), the most common method, price-to-quality scoring, is non-transparent and makes accurate representation of the procurer’s preferences difficult. In this context, Khadaroo (2008) pointed out that changes in the subjective and arbitrary weightings of non-financial qualitative criteria used to evaluate VfM may easily change the choice of the preferred bidder. Thus it is arguable that VfM evaluations are subjective and can be manipulated to show whatever its users require it to show (Grimsey and Lewis, 2005).

To tackle these problems, the criteria and weights to be applied to a multi-criteria decision context can be derived by deduction from existing policy goals and objectives, or by a procedure that leads to consensus among a group of individuals (Waara and Bröchner, 2006). To reach such a consensus, for example by constructing accounting facts, is a collective effort (Laine *et al.*, 2016). However, the greater the number of stakeholders who are involved with different agendas, the more likely that there will be different views about how to interpret VfM (Barrett, 2016). With regard to this, in debates about controversial projects, politicians may be inclined to use accounting information to accommodate their political preferences (van Helden, 2016). Moreover, different competing priorities can confuse final goals in the public procurement context (Erridge and McIlroy, 2002).

Managerial work in public procurement needs to be built upon financial facts and valuations, but these are person dependent (for example Nørreklit *et al.*, 2016). According to Butler and Ghosh (2015), individual differences in the cognitive abilities to use accounting information can lead to systematic differences in judgments. Further, Crowder (2015) studied decision-making in a public procurement context and concluded out that the key decisions were made using cognitive heuristics—there was a place for emotions and opinion rather than rational decision-making models. According to Morssinkhof *et al.* (2011), deciding which alternative purchasing option to choose involves multi-attribute decision-making, and this is cognitively challenging for human decision-makers. Clearly, the fact that

decision-makers will bring to the decision-making process emotions that are both conscious and (sub)conscious can make using public money problematic.

Even though legislation allows subjective criteria and lifecycle impacts to be taken into account, purchase price is often a very important criterion in decision-making (see, for example, Tysseland, 2008; Tagesson *et al.*, 2015). A study by Navarro-Galera and Maturana (2011) revealed that one of the shortcomings in the LCC approach concerns the difficulties of estimating costs using objective economic criteria. Furthermore, Higham (2015) noted that one of the inhibitors to using LCC is the procurers' need to budget on short-term horizons. According to Prowle *et al.* (2016), the pressures of austerity and funding cuts mean that sometimes the focus is on short-term cost savings at the expense of long-term VfM improvements. It may also be that the decision-makers are short-sighted because the links between the actual procurement and all the related outcomes are not sufficiently understood and results are often apparent only many years later (Barrett, 2016). Based on our empirical study, we claim that some of these links actually cannot be sufficiently understood.

### Empirical study

#### *Case overview and research methods*

The empirical part of this paper represents the outcomes of an indepth case study (Yin, 1981; Eisenhardt and Graebner, 2007) conducted in close co-operation with a Finnish company, 'WasteCo', which provides waste containers to private and public customers around the world. WasteCo's management was concerned about the abilities of public authorities to use MEAT and to compare the lifecycle costs of alternative waste collection methods in the pre-tendering phase. Thus, the study was prompted by the need to create tools and materials that can be used in enhancing public procurers'

understanding of qualitative issues and lifecycle perspective:

*It is extremely important that, when making a decision regarding waste collection methods, people would be aware that a decision made today will affect the costs incurring during the next twenty years (Management 5/2015).*

Typically, case studies attempt to examine particular instances of a phenomenon in its real-life context (Yin, 1981) and take advantage of rich empirical data (Eisenhardt and Graebner, 2007). This study is characterized by active researcher participation in a real-life development project, which provided a good opportunity to examine how VfM issues can be incorporated in public procurement procedures. Longitudinal data collection and analysis were used to facilitate both the practical progress at WasteCo and the theoretical inquiry.

#### *Data collection*

Ten project meetings were conducted during the study at WasteCo (see table 1). Initially, to get an overview of the business and recent tendering practices, there were discussions and semi-structured interview sessions with company personnel. Two key informants were the founder of the company and the managing director. Additionally, a controller, a development engineer, a sales assistant, and a managing director of a subsidiary were involved. The meetings with the management played a key role in this study, providing knowledge regarding the applicability of VfM.

To develop an understanding of the characteristics of public tender calls, a sample of five actual tendering cases in WasteCo's industry was analysed. In the research project, an outline of the ideal tender call and a brochure for public procurers were developed in close co-operation with the management. After the case study, further reflections on the tendering processes were attained by collecting data from

**Table 1. Data collection at WasteCo.**

<i>Date</i>	<i>Theme</i>	<i>Functions present</i>	<i>Data type</i>
01/2015	Project overview	Management	Written notes
02/2015	Project planning	Management	Written notes
03/2015	Business overview	Management, finance, development	Written notes and recordings
03/2015	Lifecycle costing	Management, development	Written notes and recordings
05/2015	Tendering procedures	Management, sales support	Written notes and recordings
11/2015	Tendering procedures	Management, sales support	Written notes
12/2015	Ideal tender call	Management, development	Written notes
01/2016	Ideal tender call	Management, development	Written notes
03/2016	Ideal tender call	Management	Written notes
03/2016	Communication	Management	Written notes



the Finnish 'HILMA' portal.

*Understanding and analysing the tendering practices in WasteCo's industry*

According to WasteCo's management, reliance on the lowest price as a winning criterion may be due to difficulties in assessing the factors that cannot be objectively measured. In addition, they have experienced that subjective measures as award criteria may lead to legal processes. The situation was described as follows:

*Six to seven years ago, we had tenders based on scoring. That is, the price was one part, there were quality, warranty issues and scoring was used without fear. However, it led to weird situations here in Finland in such a way that all tendering procedures ended up in the market court (Management, 5/2015).*

The company representatives indicated that public procurers might face challenges in tender preparation. The use of quality-related award criteria were seen as especially problematic:

*The municipalities and the cities are afraid to use scoring... Often, the problem is that the purchasing authority does not know exactly what is wanted and is not able to make accurate technical specifications... The purchasing authorities may lack expertise (Management 5/2015).*

To understand the characteristics of public tender calls in WasteCo's industry, the researchers analysed a sample of five actual cases (see table 2). The public works department of one big city (with annual purchases of a few hundred million euros) released tenders 1 and 2. In turn, tenders 3 to 5 were from solid waste management companies owned by several municipalities.

As illustrated in table 2, the lowest price contract award criteria are commonly used in WasteCo's industry. The MEAT criterion was used in two tenders: in both cases, the quality

scores were calculated on the basis of the carbon dioxide equivalent emissions of the product. In particular, the focus was on the emissions from manufacturing the product and not from waste management operations. The weightings of quality criteria versus price criteria were 10%/90% and 20%/80%.

The analysis reinforced the idea that instead of taking into account non-price factors as award criteria, it could be possible to ensure VfM by including different kinds of requirements in tender calls. One way to pursue VfM is to define sufficient technical specifications. It is important to pay attention to warranty requirements and to references from previous contracts as well. Regarding lifecycle aspects, the analysis underlined that a tender could include an obligation to ensure the availability of spare parts and maintenance for a certain time. In all, the tenders published by the large organization were much more comprehensive than the tenders from the smaller organizations.

*Increasing public procurers' awareness of the qualitative aspects and lifecycle perspective*

WasteCo's personnel believed that there is a lack of knowledge about how to gain VfM, especially by relying on the MEAT concept. Thus, an outline of the ideal tender call and a brochure, *Quality criteria and qualitative aspects in public procurement*, was developed for communication. The aim was to provide guidelines for the procurement of waste containers and to increase procurers' awareness of quality issues and lifecycle thinking.

Regarding the contract award criteria, WasteCo now proposed that suitable non-price indicators for waste containers could be, for example, the applicability for use, the quality of references, and warranty issues. Subjective scoring could rely, for example, on evaluations given by a committee dedicated to the well-being of the urban environment. A similar committee could evaluate the applicability of tendered products as well. Then scores could

**Table 2. Summary of the analysis of tender calls (MEAT = most economically advantageous tender).**

		Tender calls					
		1	2	3	4	5	
Contract award criteria	MEAT (x)	x	x	-	-	-	Lowest price (-)
Technical specification	Comprehensive (x)	x	x	-	-	-	Narrow (-)
Warranty period	> 3 years (x)	x	x	-	-	-	< 3 years (-)
Spare part availability	Requirements (x)	x	x	x	-	-	No requirements (-)
References	Needed (x)	x	x	x	-	-	Not needed (-)
The organization's size	Large (x)	x	x	-	-	-	Small (-)

be given based, for example, on the applicability to the urban environment, expectable end-user experience, and the modifiability of the waste containers' visual appearance.

According to WasteCo's management, technical standards are very useful in defining proper thresholds for product characteristics. Thus, the contracting authorities may require each tenderer to provide a test report or a certificate as proof of their compliance with the standards' requirements. To ensure the supplier's technical and professional capabilities, contracting authorities may indicate, for example, that evidence of similar deliveries is a prerequisite, or past experience should be demonstrated by a detailed list of references. It is also possible to request that the suppliers prove that their operations comply with certain quality standards. Overall, WasteCo's brochure highlighted that creating sufficient contractual agreements, covering, for example warranty issues and availability of spare parts and maintenance, could ensure the quality and required service level over the lifecycle of a product.

One of WasteCo's main concerns was that public authorities should be able to compare the lifecycle costs of alternative waste collection methods more thoroughly in the pre-tendering phase:

*We have realized that the investment cost is negligible compared to lifecycle costs... However, the price is so much negotiated even though it does not matter a whole lot. The [total] cost is somewhere completely elsewhere than at the negotiating table (Management 5/2015).*

However, a problem in waste management is that there are different stakeholders with conflicting interests. For example, the companies responsible for emptying the containers and transporting waste could get more income if the containers needed emptying more often. In turn, long emptying intervals was one of the main advantages of WasteCo's container over other types of containers. Public authorities may make procurement decisions that are not optimal from the municipal point of view, since they may disregard, for example, the cost of emptying containers over time. Moreover, the public authorities may disregard the long-term environmental/societal point of view, for example emissions from waste management operations or its quality as perceived by households.

Overall, WasteCo's longitudinal case study confirmed that achieving VfM in public

procurement is difficult. At the same time, it provided valuable insights about how economic facts (price versus LCC) and subjective valuations get intertwined.

#### *Analysing the tender award criteria in other industries*

In order to gain deeper insight into the tender award criteria, a sample of public tender calls was also analysed. This data was gathered via the HILMA portal—an electronic marketplace for public contracts in Finland. The sample consisted of 40 tender calls of devices and equipment belonging to four different categories. These devices and equipment ranged from kitchen machines to trucks. None of the analysed tenders involved waste containers, which means that these tenders represent a comparison group covering different types of procurement objects. From each category in this comparison group, the latest 10 tender calls were selected for analysis. The results presented in table 3 indicate that public authorities rely on MEAT more often than the lowest price when they are purchasing devices and equipment. This is noteworthy when the ambiguity of MEAT concept is taken into consideration.

The most commonly used criteria were related to technical features and after-sales service. In several cases, scores were awarded if a particular technical requirement was met. Regarding after-sales, for example, service response time and availability of services for a certain period of time were used as the basis for awarding scores. In turn, functionality was scored, for example, based on user experience information. Only in one case (included in 'other' criteria in table 3) was the scoring based on energy consumption of the equipment, which would be an element of lifecycle costs. In all, the results showed that practitioners were using the same kinds of criteria as in the procurement of waste containers.

It is possible to define unambiguous and quantifiable quality criteria, such as the results of test measurements of laboratory devices. However, most quality criteria, are subjective in terms of defining the parameters and then assessing them. In one case of using the MEAT criterion, for example, tenderers were asked to estimate based on the given scale how much the offered solution would affect workload and ergonomics. Clearly, evaluating ergonomics is susceptible to subjective opinions and is difficult to value in monetary terms. Therefore, when it comes to non-quantifiable criteria, ambiguity is unavoidable. However, LCC, among other approaches, could help in providing structure

and a common basis for an assessment discussion regarding multifaceted procurement objects.

### Discussion and conclusions

Based on our literature review, longitudinal case study, and public data, it is clear that different stakeholders can have very different ideas concerning what VfM is. In addition, there are numerous possibilities to evaluate VfM based on substantive quality criteria. Thus, besides the potential benefits that pursuing VfM with the help of MEAT could generate, there are several barriers and drawbacks that limit its value in practice. This paper sheds light on the possibilities and challenges in engaging economic facts and subjective valuations when considering and assessing VfM in public procurement.

The study suggests that, when using MEAT, the procurement of simple products like waste containers is complex, and it is extremely hard to get objective and measurable quality criteria. Our findings from WasteCo's experience elaborate on the finding of previous literature (Tagesson *et al.*, 2015) that, in order to avoid subjective assessments and reduce the risk of appeals, price is often the predominant factor in public procurement. In turn, the analysis of the award criteria used in other industries revealed that contracting authorities are more and more relying on MEAT. This may be the result of recent public procurement legislation encouraging the use of qualitative criteria in tender awarding. However, we believe that MEAT leads to ambiguous decision criteria and should be used with care.

In particular, by building on Bröchner *et al.* (2016), this paper suggests that it is worth considering whether it is necessary to use qualitative award criteria or pursue VfM by simply relying on appropriate quality requirements. More particularly, one approach

to the problem of valuing quality is to enter all necessary requirements in the specifications and then award the tender based on price alone. In turn, it is possible to proceed with looser criteria and select the tender with the best price–quality ratio. This approach requires scoring the qualitative aspects but may allow more suppliers to participate in the tender competition. However, pursuing VfM by relying on quality requirements alone may not always ensure VfM from the perspective of LCC. Thus an ideal solution could be to include sufficient quality criterion in the specifications and use MEAT in contract awarding.

The paper proposes that LCC enables highly relevant cost scenarios of alternative technical solutions. In the waste management sector, for example, different collection methods differ significantly in terms of lifecycle costs and environmental effects (Teerijoa *et al.*, 2012). As suggested in the literature (Tarantini *et al.*, 2011), this paper strengthens the idea that a lifecycle approach is not only a comprehensive criterion in tender evaluation, but it is an approach to analysing economic and environmental issues within tendering procedures. In line with observations by McKevitt and Davis (2016), this study suggests that the potential of VfM should be assessed already in the pre-tendering phase, for example, with the help of LCC.

However, LCC might be difficult to implement in practice, because it requires new skills from people who are working with tenders—on both sides of the table. Regarding this, Erridge and Hennigan (2012) suggest that shared practices are likely to be effective in building the confidence needed to use complex tender evaluation criteria. Actually, general level guidance and shared understanding regarding good practices for MEAT, LCC, and transparency exist (for example Directive 2014/

**Table 3. The percentage of cases in which the criteria was used in tender awarding (*N* = number of cases studied).**

	<i>Total</i> ( <i>N</i> = 40)	<i>Laboratory</i> ( <i>N</i> = 10)	<i>Industry</i> ( <i>N</i> = 10)	<i>Electricity</i> ( <i>N</i> = 10)	<i>Transportation</i> ( <i>N</i> = 10)
<i>Lowest price</i>	25%	10%	20%	30%	40%
<i>MEAT</i>	75%	90%	80%	70%	60%
<i>Quality criteria</i>	13%	0%	10%	40%	0%
<i>Technical features</i>	38%	70%	40%	20%	20%
<i>After-sales services</i>	33%	40%	30%	20%	40%
<i>Functionality</i>	25%	40%	10%	10%	40%
<i>Delivery time</i>	18%	30%	10%	30%	0%
<i>Performance</i>	15%	30%	0%	10%	20%
<i>Warranty issues</i>	15%	20%	0%	30%	10%
<i>Other</i>	15%	0%	10%	0%	50%



24/EU). However, because every procurement is different in its nature, it may not be possible to identify commonly agreed upon scoring rules and calculation methods that practitioners should use. As VfM can be achieved in many ways, a certain level of ambiguity needs to be tolerated and accepted while focusing on transparency in the procurement process.

As described in the literature (Falagario *et al.*, 2012), awarding public tenders may become a time-consuming and expensive process when both prices and qualitative issues are being considered. Hence, the cost/benefit trade-off of obtaining the additional information needed for comprehensive cost analysis should be recognized (Van den Abbeele *et al.*, 2009). In that sense, it is reasonable that contracting authorities are qualified to choose and execute the appropriate method and award criteria for each different case. For example, organizing test measurements for laboratory devices might be laborious, but could enable objective and unbiased comparison of alternatives.

Finally, the key contribution of this paper is that defining absolute VfM may be impossible because of the multi-dimensional and complex nature of public procurement. Therefore, LCC and other approaches will at least give structure to the expected impacts of the complex procurement case, and thus partly overcome ambiguities related to them.

Waste management, for example, has society-level effects: economic effects through waste collection costs; as well as long-term environmental/societal effects through emissions and perceived service quality (Reich, 2005; Teerijä *et al.*, 2012). In line with earlier observations (Karmperis *et al.*, 2013), this study suggests that public authorities' decision-making regarding waste management is hampered by public sector fragmentation: various stakeholders have conflicting interests, for example one stakeholder's earning logic incurs costs and emissions for another. Building on that, this paper suggests that such fragmentation might cause the VfM for an individual public authority to conflict with the VfM for the whole society, i.e. fragmentation would cause suboptimization in public procurement (see Heald, 2003).

#### Limitations and further research

The research was limited to one indepth case environment in the Finnish waste management context. Further studies could enhance the generalizability of the findings by gaining evidence from more cases across different sectors. As illustrated by a larger sample from

the Finnish HILMA database, the difficulties of defining objective and measurable quality criteria might be the case more broadly as well. Indeed, we have little reason to believe that other contexts would be different. However, in order to get a comprehensive understanding of the topic, an indepth involvement with one case company was required.

In terms of future research, it would be necessary to further analyse the approach of using representative committees in evaluating subjective and non-quantifiable tender award criteria. In addition, to achieve generalized findings and to establish correlations between variables such as procurement approaches, organizational capacity, and legal complaints, more quantitative research based on large datasets is needed. Moreover, further research could consider how to exploit LCC in tender selection: by whom in practice and through which kinds of processes?

#### IMPACT

Policy-makers and managers need to be aware that different stakeholders could have different views of what value for money (VfM) is. The authors present a new way of overcoming VfM challenges. They show that lifecycle costing (LCC) provides clear benefits for public procurers to assess the potential for VfM in the pre-tendering phase.

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## **ARTICLE II**

Lindholm, A. & Suomala, P. (2007)

Learning by costing: Sharpening cost image through life cycle costing?

*International Journal of Productivity and Performance Management*

Vol. 56, No. 8, pp. 651-672





# Learning by costing

## Sharpening cost image through life cycle costing?

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Learning by  
costing

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Received March 2006  
Revised March 2007  
Accepted March 2007

### Abstract

**Purpose** – The purpose of this paper is to discuss life cycle cost management and highlight the practical challenges related to collecting adequate data and practicing long-term cost management in an uncertain environment.

**Design/methodology/approach** – The paper reports a case study conducted in the Finnish Defence Forces. As part of the case study, a life cycle cost model for a case product was developed.

**Findings** – Activity-based life cycle cost modeling can provide relevant information for varying product management needs at different stages in the life of a product. Quantification of uncertainty is one of the elements in the modeling that can improve the feasibility of LCC both for cost estimation and tracking purposes.

**Originality/value** – Only a few empirical studies on life cycle costing have been reported which focus on the defence sector. The paper contributes to our understanding of how LCC can be used in a continuous manner and depicts how LCC can produce a sharpened cost image of a particular product.

**Keywords** Learning, Life cycle costs

**Paper type** Case study

### 1. Evolving life cycle cost management

Life cycle costing (LCC) is an approach within the field of management accounting which focuses on the total costs that occur during a product's life[1]. It is possible to identify two distinct dimensions of life cycle costing:

- (1) estimating costs on a whole life cycle basis; and
- (2) monitoring the cost incurred throughout a product's life cycle (Jackson and Ostrom, 1980; Taylor, 1981; Booth, 1994; Woodward, 1997; Asiedu and Gu, 1998).

The total costs can be considered from diverse points of view – for example, from the point of view of the product's supplier or of the product's user or owner, or even more broadly from the point of view of society.

LCC can be seen as a way of thinking and not merely as a costing tool because in addition to the management of costs, it focuses on the long-term performance of products by employing a variety of management accounting methods. A basic assumption behind the LCC approach is that it is usually possible to affect the future costs of a product beforehand, either by planning its use or by improving the product or asset itself (Markeset and Kumar, 2004). In practicing LCC, it is necessary to comprehend the interaction of the cost items that accumulate among the relevant stakeholders during the different life cycle stages. Continuing product development



International Journal of Productivity  
and Performance Management  
Vol. 56 No. 8, 2007  
pp. 651-672  
© Emerald Group Publishing Limited  
1741-0401  
DOI 10.1108/17410400710832985

can lead to progressive solutions that lower the societal costs derived from pollution of the environment, but on the other hand these solutions will result in higher manufacturing costs as a product may require more expensive components and materials. The production of more expensive materials can, in turn, have a greater environmental effect and thus add to the societal costs. With this holistic approach, one quickly notes that an extensive and detailed implementation of life cycle costing easily leads to highly diversified and laborious analyses of cause and effect. Still, to avoid partial optimization, costs ought to be studied with regard to the total situation. Knowing the life cycle costs of a product is one of the basic requirements when one is considering, for example, the outsourcing of functions and ownership, or when one wants to offer one's capacity for use by the other organizations in the supply chain. As the most holistic interpretation of LCC may be too laborious to implement, in an individual organization it is possible to adopt a much simpler starting point. Thorough surveillance of the acquisition and operational costs of a specific product from the point of view of one actor – the company itself – can expose the cost structure of a product and reveal several interesting causalities.

Contingency theory emphasizes the relationships between the design and functioning of an organization and different contingent factors such as environment and technology (see, e.g. Otley, 1991; Covaleski *et al.*, 1996). Accordingly, the characteristics of different control systems applied in organizations can also be reflected against the relevant contingent variables. Dunk (2004), for example, points out that the use of management control systems such as life cycle costing may be contingent on the characteristics of the firm: organizations with products at an early stage of their life cycle are likely to use LCC as a planning device rather than as a control tool, whereas in firms with more mature products the focus may shift more toward control. Considering the number of objectives associated with LCC – including the comparing of actual and budgeted costs, the facilitating of better pricing decisions, improved profitability assessment, enhanced understanding of products' environmental effects, and focusing on the costs incurred after purchasing or development (Woodward, 1997; Emblemssvåg, 2001; Dunk, 2004) – it is likely that the relative importance of these objectives will vary over the different phases in the life of a product.

The paper highlights the practical challenges connected with collecting adequate data and practicing long-term cost management in an uncertain environment. The paper shows that the characteristics of and the results obtained by LCC will – due to a number of issues in connection with the availability and quality of input data, decision-making needs, and relevant stakeholders – evolve from the beginning of a product's life to the final phase of its disposal. The paper is based on a study conducted in the Finnish Defence Forces (FDF). The unit of LCC analysis was a product – a field gun – that belongs to the fixed assets of this organization. As a consequence, the study adopts a customer's perspective on LCC. Thus, the costs that are caused by the acquisition, operation, and maintenance of a product were the main focus of the life cycle cost analysis.

The paper contributes to our understanding of how LCC can be used in a continuous manner and depicts how it can produce a sharpening "cost image" of the product in focus. The term "cost image" is used in this study in referring to the idea that cost



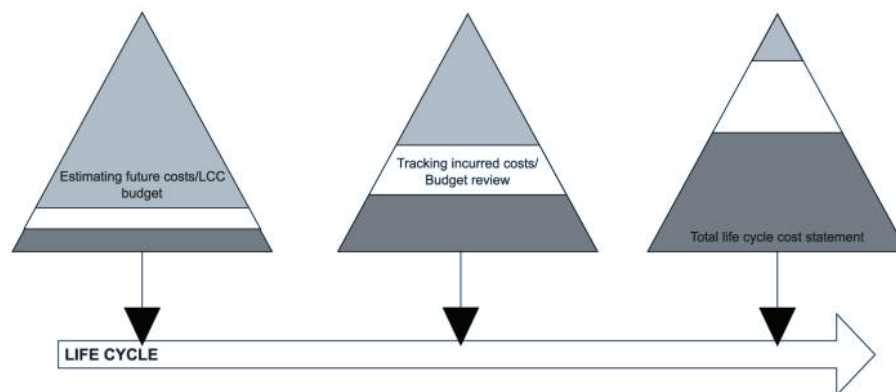
consciousness (see, e.g. Uusi-Rauva and Paranko, 1998), especially in the life cycle costing context, requires understanding of a product's cost history and its current cost behavior together with an estimate of its future costs. Thus, to comprehensively grasp the costs associated with a certain cost object, one could combine these three factors into a "cost image".

The question of which costs should be included in LCC analyses receives different answers, depending on the purpose of the costing (Hochschorner and Finnveden, 2006). In line with this, the cost image could be seen as a dynamic framework that gains in accuracy and informational content over a product's life. Performance measurement – including cost accounting – should be able to respond to the developing needs of decision makers in different life cycle phases (Werner and Souder, 1997; and for discussion related to the impact of context on the realization of LCC see also Kirkpatrick, 2000) and should help to provide answers to the following challenges connected with product management:

- (1) *At the beginning:*
  - comparing and ranking alternatives;
  - assessing total economic impact; and
  - adjusting proper (e.g. maintenance) resources.
- (2) *In the middle:*
  - continuous cost management and finding the optimal practices for utilization;
  - learning from estimation errors, improving costing practices; and
  - determining the optimal length of life cycle.
- (3) *At the end:*
  - making actual product-specific cost calculations and a total financial statement for a product; and
  - collecting information on actual activity unit cost and driver amount as input data for future investments.

All the necessary features of the cost image of a product are actually inherent in the concept of LCC, but the practical application of cost image thinking requires full and continuous utilization of LCC from the beginning to the final phases of life cycle. Importantly, the estimation of future costs, which is an essential feature of LCC, should be complemented with sufficient cost monitoring during a product's life cycle (Taylor, 1981; Woodward, 1997). In fact, during the life cycle the emphasis of LCC shifts essentially from cost estimation to cost monitoring (see Figure 1). At the beginning of the life cycle, LCC corresponds mainly to the estimation of future costs (the leftmost triangle in Figure 1). Over time, the focus gradually shifts to monitoring the incurred costs, and the estimation of future costs is increasingly based on the analysis of past cost (the central triangle in Figure 1). At the end, cost estimation has little value for the decision maker, whereas properly collected cost data would allow making an overall LCC statement that illustrates the total impact of the product on the organization (the rightmost triangle in Figure 1).





**Figure 1.**  
The changing focus in  
LCC during a product's life  
cycle

**Source:** Suomala *et al.* (2004)

From the methodological perspective, the paper should be labeled as a case study. Case studies can be applied especially when the interest is on the dynamics of a phenomenon or phenomena within a specific context (Eisenhardt, 1989). As Yin (1994) points out, case study is a research approach rather than a distinct method: several methods of data collection and analysis can be applied in case studies. This study, which was carried out between February 2004 and December 2004, employed a number of methods: modeling and simulation was used for constructing a life cycle costing framework. Participation or observation (ca. 14 days) in the organization was needed for understanding the context and collecting part of the input data for cost modeling. Interviews and group interviews ( $n = 12$ ) were used both for collecting cost data and for reflecting the impacts of LCC in the case organization. The practical – or managerial – motivation for the case study was the concern of the management of the case organization that the level of life cycle cost consciousness in the organization was not adequate for controlling the cost effects of material investment decisions. In other words, the present cost accounting and cost management practices did not support systematic learning from material cost behavior.

The remainder of the paper is structured as follows. Section 2 contains a literature review and discusses life cycle-based cost management in organizations. Section 3 provides the empirical part of the paper and describes the life cycle costing process in the case organization. Section 4 discusses the findings and provides conclusions.

## **2. Life cycle matters – motivation for accountability**

Traditionally – looking at the product costs from the supplier's perspective – it has been claimed that up to 80-90 percent of the product cost that will eventually be incurred is already determined (committed) during product and production development (see, e.g. Raffish, 1991; Ax and Ask, 1995, p. 134; Asiedu and Gu, 1998; Uusi-Rauva and Paranko, 1998). Such a claim is likely to put the emphasis in profitability management quite strongly on product development and design. Somewhat in contrast with this, Cooper and Slagmulder (2004) recently argued that

companies can achieve significant savings during product life cycle even in an environment of products with short life cycles and aggressive cost management focused on product design. Consequently, firms should practice active profitability management not only during the design phase but also during the rest of the life cycle. Naturally, this interpretation is not a totally new one and it is supported by studies that emphasize the impact of after sales on a product's overall profitability. A number of observations suggest that in many industries – including electronics, communication, machine construction, and the car industry – the after sales period is a substantial contributor both in terms of total product revenues and, in particular, generated profits (Cohen and Whang, 1997; Suomala *et al.*, 2002a, b).

From the customer's or user's perspective, a similar logic of incurred costs and the costs to which one is committed can be applied. After making a purchasing decision, a company will be largely committed to the costs that will later be incurred, for instance in the form of maintenance, repairs, energy, staff needed, and disposal. Of course, this does not mean that these costs cannot be affected at all during the life cycle of a product. Costs can be managed for example by optimizing maintenance strategy, by educating the individuals that use the product, or by developing a more efficient way to utilize the product. On the other hand, it is clear that different product alternatives or technology platforms may cause different costs, and therefore it is essential to practice LCC in the acquisition phase in order to be able to avoid unnecessary under- or over-estimations of total costs (or phase-specific costs (see Barringer and Weber, 1996)) associated with a product. Due to the large amount of after purchase costs in many cases, it is sometimes very difficult to gain a realistic perception of overall costs without a systematic life cycle analysis. In line with this, LCC was first used for the forecasting of future costs in the acquisition phase of products (Asiedu and Gu, 1998; Emblemsvåg, 2003). The starting point in product life cycle cost estimation is to understand the nature of a product's life cycle and the activities that are performed during its phases. Cost drivers may differ from one product to another, which makes the identification of the main cost drivers both important and challenging (See, for example, Janz *et al.*, 2004).

During the acquisition phase, many companies produce an estimate of costs and revenues associated with the investment through traditional capital budgeting. In this process, typical methods include net present value (NPV), internal rate of return (IRR), and payback (see, for example, Keloharju and Puttonen, 1995; Lukka and Granlund, 1996; Neilimo and Uusi-Rauva, 2005). When conducted properly and sufficiently extensively, this can be perceived as a starting point for life cycle costing. However, it is important to perceive the process of capital budgeting as an input for continuous life cycle cost management rather than as a costing output that can be – in the worst case – archived and forgotten. In this respect, it is unfortunate that many companies neglect comparisons of actual and budgeted costs (Järvinen *et al.*, 2004) and thus lose the possibility to learn from the product's cost behavior during its life and eventually to make more accurate or realistic cost estimations.

In practice, several problems or deficiencies have been identified in connection with both estimating the future costs and tracking the historical cost behavior of products, customers, or other cost objects over a long period. Collan and Långström (2002) have found that more than half of companies do not have specific decision

support systems for investment planning. In addition, Uusi-Rauva and Paranko (1998) point out that cost accounting practices in Finnish companies are not fully able to support or respond to various needs of product development. Although the lack of utilization of different costing methods is not the sole reason for this, it is clearly part of the problem: for instance, according to Hyvönen (2000), only 6 percent of Finnish companies have used LCC. This applies not only to Finland as the practical application of approaches similar to LCC, such as total cost of ownership (TCO), has been found to be quite limited in international studies (Ellram and Siferd, 1993). There is evidence that life cycle impacts tend to be neglected and that the initial purchase cost is often a very important criterion when making purchasing decisions (e.g. Ahmed, 1995; Järvinen *et al.*, 2004).

Both for estimating and budget review purposes, adequate costing data needs to be collected. In this respect, companies' costing practices form the basis for cost monitoring during the life cycle and here the ability to assign costs to specific products is central. In addition to financial information, the collection and analysis of operational data is an essential part of life cycle costing because this data can be utilized in identifying relevant cost drivers for products. It is likely that quite a lot of information for LCC purposes exists in different forms; the problem is that the data is not brought together in a coherent way (Taylor, 1981; Wouters *et al.*, 2005). In fact, the unavailability of adequate costing data is considered to be one of the main barriers to implementing total cost analysis approaches (e.g. Ellram, 1995).

Irrespective of the quality of present data, life-cycle analyses always include elements of uncertainty because part of the input data has to be defined on the basis of different estimations and assumptions regarding the development of costs and revenues in the long run. It has been recognized that probability methods are useful in handling uncertainty in cost models (Asiedu *et al.*, 2000; Emblemsvåg, 2003; Nachtmann and Needy, 2003). Thus, instead of treating as fixed the input variables relating to, for example, performance, quality, and price requirements, it is more appropriate to quantify them in terms of probability distribution functions (Asiedu *et al.*, 2000; Jiang *et al.*, 2004). According to Emblemsvåg (2003), the Monte Carlo simulation is an especially useful method for cost management purposes.

The Monte Carlo method can be used to assess the impact of uncertain input variables on the outcomes. It is applied in a number of areas, such as in economics, biology, chemistry, and engineering (Emblemsvåg, 2003). For example, Nachtmann and Needy (2003) have used Monte Carlo simulations for handling uncertainty in activity based costing (ABC) systems, and Liu and Frangopol (2004) have used them for optimizing maintenance policies. Furthermore, Emblemsvåg (2003) has used Monte Carlo methods for various life-cycle costing (LCC) applications. The aim is to model uncertainty in the life cycle model's input variables by using probability distributions in order to be able to numerically measure the effect this uncertainty has on the output variables. If historically collected data exists, the probability functions can be determined on the basis of past experience. However, in most cases the forms of the distributions are based on estimates that do not directly stem from historical data and therefore their accuracy is questionable. Furthermore, the accuracy of the estimates depends on the forecasting period. Multiple replications of the simulation models are

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run, resulting in a distribution of possible outcomes and the probabilities that these values will occur. In addition, by conducting sensitivity analysis, one can identify which input variables are the most important with respect to managing the uncertainty. The case study reported in the next section highlights the practical challenges related to collecting adequate data and practicing long-term cost management in an uncertain environment on the basis of cost image thinking and numerical simulation.

### 3. The case – need to understand life cycle costs

#### *Research project*

The study was conducted in the Finnish Defence Forces. It is a characteristic of the FDF (from now on “the organization”) that the different parts of the organization are responsible for the acquisition, utilization, and maintenance of defence material (from now on “products”). In addition, some activities, such as the most demanding maintenance tasks, are outsourced. The distribution of responsibilities, among other things, results in fragmented product-related cost consciousness within the organization. However, as a rule of thumb, about 30 percent of the annual expenses (ca. 600 million Euros) are allocated to the acquisition of new products and systems. Further, the organization uses many different products with usually long-term cost effects and it has been estimated that the acquisition costs represent roughly only one third of the total life cycle costs of a particular product or a piece of material. This would imply that the costs directly associated with the products constitute a major portion of total expenses. Naturally, the long-term cost structure is essentially dependent on the type of material in question, but overall effective cost management covering the entire life cycle of products is very important for the organization. Quite recently, the organization has increasingly struggled with high costs associated with using products, which has resulted in demands to reduce product-based military training – and overall – the utilization rate of many products. Thus, to enhance rational long-term planning, the organization has faced pressures to improve the ability to anticipate the life cycle costs of a product before the decision to invest in it. In this way the organization would be better able to utilize its resources and financial abilities effectively. A tool that is perceived as capable of responding to these pressures is LCC. A research project was set up to seek tools for improving long-term cost consciousness in the FDF. The objective was to develop a general template for an LCC model which could be applied in estimating and tracking the life cycle costs from acquisition to disposal.

The project conducted during the year 2004 was organized around the analysis of a case product which was a field gun. The focus was on the costs that are directly associated with the case product although the utilization of the product requires support also from other systems (such as vehicles), the costs of which were excluded from the analysis. The main reason for selecting the field gun as the case product was that it had been used actively for over a decade and the organization had collected data that partly depicted the historical use and maintenance activities related to the product. Long storage periods are typical of the product and it can be stored continuously for many years between active utilization phases. The product had been used most actively at the beginning of the life cycle and its use was

anticipated to decrease until the end of the life cycle. Also, regarding this product, the responsibilities for life cycle activities such as acquisition, utilization, maintenance, storage, and disposal, were distributed among the different organizational units. Responsibilities for maintenance, for example, were further distributed both to the final users and to the service department, depending on the type of maintenance task. In addition, the most demanding maintenance tasks were outsourced to the manufacturer of the product.

The modeling of life cycle costs was divided into two phases:

- (1) collection of the historical data; and
- (2) construction of the model.

The modeling started with an analysis of the life cycle of the case product in cooperation with the representatives of the organization. The main contacts were from the department which is responsible for managing maintenance and storage activities. The issues concerned were the activities related to the case product during its life cycle, the total activity costs, and the amounts of activity drivers. Overall, 15 activities related to the case product from acquisition to disposal were identified. The focus was on the costs that can be unambiguously associated with the case product; cost elements related to product acquisition, implementation, use, maintenance, warehousing, and disposal were taken into account in the modeling. Thus, for example, the general costs related to military training (although partly related to this case product) were excluded from the model.

Analyzing the historically collected data was an essential part of the project. Data related to the use and maintenance of products was collected from the product-specific maintenance manuals in which the data covering the whole life cycle have been documented. Approximately 20 percent of the case product fleet in the organization was examined in this study. The most essential data collected from the maintenance manuals was: the number of shots, the amount of transportation, and the service and repair tasks as a function of time. The manner of using the case product in different life cycle stages and the differences between individual products were analyzed on the basis of the data collected on shots and transportation. The data on maintenance and repair tasks was used to determine the maintenance history of the average case product. The analysis revealed that the number of shots and the amount of transportation varied a lot between individual products and between life cycle stages. In contrast, there were no substantial differences between the individual products regarding maintenance and repair tasks. The data on the differences between individual products and between life cycle stages was further utilized when modeling the uncertainty.

The product- and activity-related cost information was obtained indirectly from the organization's databases through interviews and questionnaires intended for maintenance and IT personnel. The specificity of the available costing data varied a lot, which affected the modeling of the costs. For example, historical data related to part of the repair tasks was not collected at all in the organization and thus historical data collected on a corresponding product had to be utilized. On the other hand, accurate cost information based on invoicing was available regarding outsourced maintenance and repair tasks.



*Description of LCC model*

The model has been constructed with MS Excel and the uncertainty inherent in input variables has been modeled with @Risk software. The model is based on the principles of activity-based costing (ABC), although it should not be seen as the most classical example of ABC. The model calculates activity unit costs on the basis of available product-specific basic information (resource consumption and resource costs) and assigns costs to a product on the basis of information on known or estimated activity driver amount for each period of product life. In the model, the life cycle of a product is divided into a feasible number of distinct calculation periods. This number can be defined by the user. Of course, there are always uncertain elements affecting life cycle costs. Because exhaustive historical data related to a case product has not been collected before in the case organization, uncertainty related to input data (e.g. actual activity driver amount and activity unit cost) was taken into account in modeling the incurred costs. In addition, there was a lack of information about the utilization of the case product in the future and thus the modeling of future costs had to be based on assumptions, partly relying on historical experience.

Two basic methods are available for measuring the economics of product life cycle. Profits and losses that are caused by products throughout their life can be measured either by accrual accounting or the cash flow method. Each approach has its strengths and weaknesses. In this case, the life cycle costs are modeled as cash flows during product life. Thus, the model can best capture the development of product-related sunken costs as a function of time in an environment where the residual values of the material are often irrelevant. This means that, for example, purchase costs are not represented as depreciations but modeled as non-recurring payment at the beginning of the life cycle. An exception to this is that the cost of capital related to spare part and accessory inventory is seen as a recurring cost during the whole life. Apart from this, an organization could affect the timing of expenses by employing different financing models. However, to better understand the cost behavior of the product, the effects of different financing methods on the incurred costs during life cycle have not been taken into account in the model.

The modeling was based on the idea that total costs of a product fleet can be calculated on the basis of individual product costs. However, the individual products are utilized in different ways and in different circumstances, which should be taken into account when modeling the costs of the whole product fleet. Because the historical data was determined on the basis of a sample from the whole product fleet and thus the differences within the whole fleet could not be quantified accurately, the differences between product individuals constituted yet another source of uncertainty. If historical data covering the whole product fleet was available, the uncertainty related to the differences between individual products would not need to be taken into account in retrospective analysis.

The model is composed of four Excel sheets. On the first sheet (see Table I) the user defines the basic cost information, such as resource costs, resource allocations to activities, and other elements affecting activity unit costs. In addition, other product-related input information, such as the size of the product fleet, the assumed inflation, and the cost of capital, is covered in the first sheet. The basic information is further utilized on the other sheets.

**Table I.**  
Example of key input  
data (sheet 1)

Input parameter	Unit
Fleet size	Pieces
Length of calculation period	Years
Inflation	Percent
Cost of capital	Percent
Spare part inventory size;value	Pieces/item; price/item
Purchase price, product	Euros
LC stage specific resources	
Acquisition	Euros/hour;Euros/piece;Euros/km;Euros/sqm
Implementation	Euros/hour;Euros/piece;Euros/km;Euros/sqm
Active use	Euros/hour;Euros/piece;Euros/km;Euros/sqm
Disposal	Euros/hour;Euros/piece;Euros/km;Euros/sqm
Supporting activities	Euros/hour;Euros/event

The second sheet (see Figure 2) of the model is for constructing the basic profile for the product life. It comprises all the activities, the activity unit costs, and the expected amount of activity drivers as a function of time. The model calculates the activity unit costs on the basis of the basic information reported on the first sheet and it is possible to determine if the activity costs are assigned to the whole product fleet or to an individual product. On this sheet the user also determines all the uncertainties related to the activity driver amount (Each shell that may contain uncertainty is marked with a star). In the absence of reliable data, normal distribution can be assumed for each variable, but when the uncertainty is expected to be asymmetric, triangular distributions are more suitable. As a consequence, triangular and normal distributions were utilized for modeling the uncertainty regarding variables on the first two sheets. The parameters of uncertainty distributions for the periods before year 2005 were determined on the basis of the empirical data, and parameters for the periods after year 2005 were derived by extrapolating the historical development of the parameters.

The third sheet of the model presents periodically all the activities, the assignment levels of the activities, the expected amount of activity drivers, and the activity costs which are calculated on the previous sheets. Only the uncertainty coefficients related to differences between individual products are determined on this sheet. The logic is as follows. The result of the multiplication of the expected amount of activity driver (determined on the second sheet) and the uncertainty coefficient is the calculated amount of the activity driver. To get the total activity cost in a particular period, the calculated amount of the activity driver is multiplied by the activity unit cost. (Figure 3) The left side of Figure 3 illustrates the possible values and their probabilities for uncertainty coefficients, which are modeled as discrete distributions. Uncertainty coefficients can be seen as probabilistic multipliers, which are used in simulation to quantify the deviation from the expected value. Discrete distribution was, in this case, a feasible way to model the uncertainty related to many key variables, such as the number of shots during a given period. This is due to the fact that on the basis of scarce historical evidence, the differences between product individuals were substantial and seemingly random, making it difficult to utilize a theoretical distribution. More data

Activity unit costs and driver amounts

ID	1		2		...		N	
	Activity #1		Activity #2		...		Activity #N	
	x		x		...		x	
Assign level, population								
Assign level, single product								
	Unit cost	Driver amount	Unit cost	Driver amount	Unit cost	Driver amount	Unit cost	Driver amount
Period 1	X €	N*	X €	N*	X €	N*	X €	N*
Period 2	X €	N*	X €	N*	X €	N*	X €	N*
Period 3	X €	N*	X €	N*	X €	N*	X €	N*
Period 4	X €	N*	X €	N*	X €	N*	X €	N*
Period 5	X €	N*	X €	N*	X €	N*	X €	N*
Period 6	X €	N*	X €	N*	X €	N*	X €	N*
Period 7	X €	N*	X €	N*	X €	N*	X €	N*
Period 8	X €	N*	X €	N*	X €	N*	X €	N*
Period 9	X €	N*	X €	N*	X €	N*	X €	N*
Period 10	X €	N*	X €	N*	X €	N*	X €	N*
Period 11	X €	N*	X €	N*	X €	N*	X €	N*

Figure 2.  
The structure of the  
second sheet



might enable fitting the empirical data to any theoretical distribution instead of using an empirical distribution (such as discrete distribution).

The accumulated life cycle costs are presented periodically both at discount values and at nominal values on the fourth sheet of the model (Figure 4). Both the product-specific costs and the total cost of the whole fleet are presented. In addition, the activity-based cost structure is presented both at absolute values and at relative values. The Excel model calculates numerically (e.g. Monte Carlo sampling) by means of @Risk software the life cycle costs in distribution form by combining all the identified uncertainties in input data. In other words, the model shows all the possible outcomes given the uncertainty of input variables. It is also possible to perform a sensitivity analysis which identifies the most significant inputs and their associated correlation coefficients.

*Toward cost image – life cycle costs in three stages of product life*

The idea of the evolving use of life cycle costing during a product's life cycle is illustrated in this section. Since the availability and quality of the input data usually increase during the life cycle, this provides a possibility to sharpen the cost image of the product during its life. The changes in the accounting environment and the effect of this environment on life cycle cost modeling are illustrated using three evolving versions of the model presented in the previous section. The different versions of the model describe the perception of life cycle costs at three successive points in time:

- (1) the beginning of the life cycle (stage 1);
- (2) after one-fifth of the life cycle (stage 2);
- (3) at the time of the research project (stage 3).

It has to be noted that the first two versions of the model are somewhat hypothetical; they are formulated on the basis of present knowledge. At the time of the project it was not possible to tell exactly what the situation was in stages 1 and 2. However, the constructed model has been utilized in simulating different situations during product life as realistically as possible. Modeling is based on the assumption that the cost accounting practices of the case organization are not evolving during the life cycle. Thus, the quality of cost information – such as the knowledge on activity unit costs – remains the same throughout the life cycle.

Ideally, the first life cycle cost calculation should be done at the beginning of the life cycle. In that case, the calculation has to be based on the different estimations that illustrate the manner of using the product in the future and on the information on activity costs. One way to define the amount of activity drivers is on the basis of the

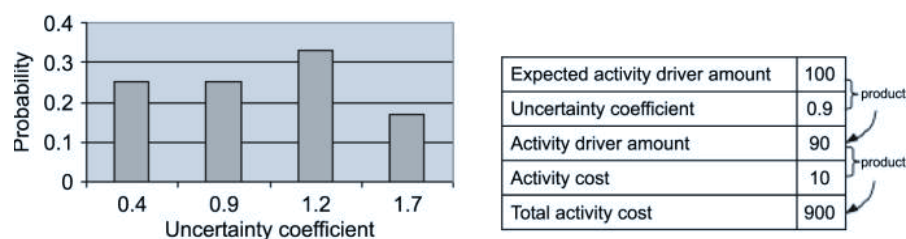


Figure 3.  
Modeling uncertainty as  
discrete distribution

Life Cycle Costs

Nominal  
values

	Period 1	Period 2	Period N
1) Assign level, population	- €	- €	- €
2) Assign level, single product	- €	- €	- €
3) Total costs (1+2)	- €	- €	- €
4) Cumulative costs	- €	- €	- €
5) Total costs per product (3/#products)	- €	- €	- €
6) Cumulative costs per product (4/#products)	- €	- €	- €

Discounted  
values

Total costs	- €	- €	- €
Cumulative costs	- €	- €	- €
Total costs per product	- €	- €	- €
Cumulative costs per product	- €	- €	- €

Activity-based CBS

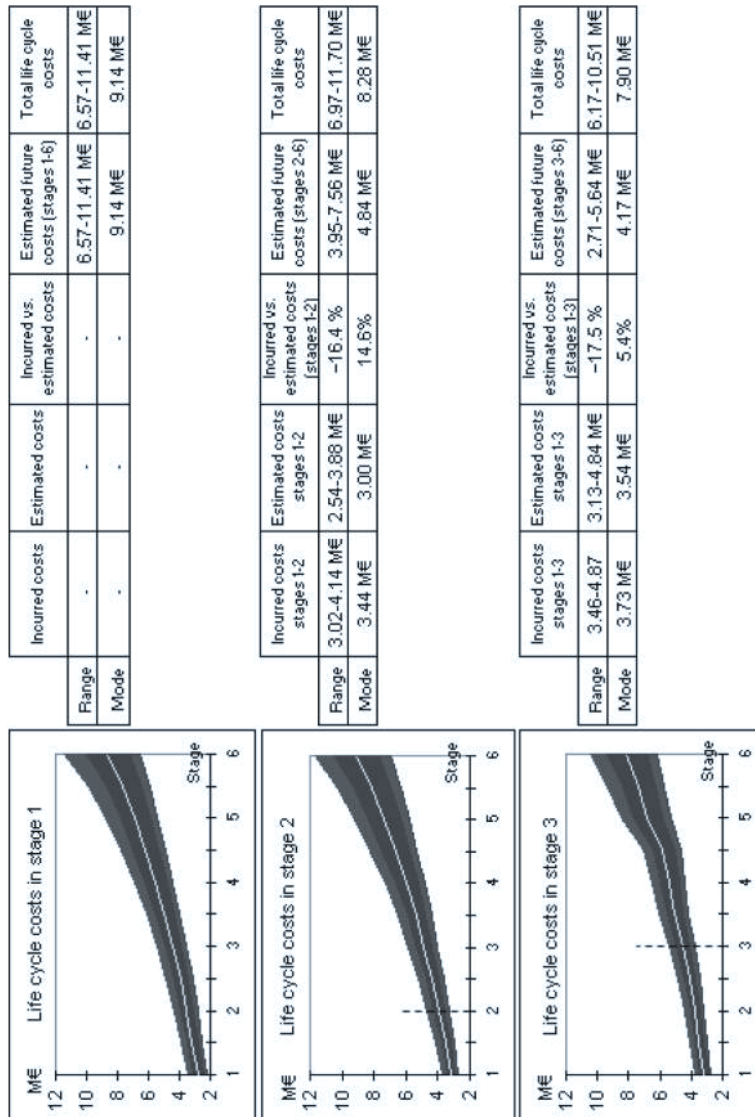
Activity name	Period 1	Period 2	Product life
Activity #1	- €	- €	- €
Activity #2	- €	- €	- €
Activity #N	- €	- €	- €

**Figure 4.**  
Example of information on  
the fourth sheet

product's utilization plan and the activity costs, for example employing activity-based costing. It is also possible that the supplier of the product provides the customer with some information regarding the reliability, availability, maintainability, and supportability (RAMS) of the product. RAMS figures can be utilized especially in estimating the maintenance costs. Because of the lack of certain empirical information at the beginning of the life cycle, modeling of uncertainty is an essential feature of LCC at this stage, when even the most fundamental factors, such as estimates of the length of the life cycle, may be uncertain. In addition, it may be impossible to recognize all the relevant activities related to a product during its life cycle and thus some activities may be ignored in the modeling. For example, the requirements for product modifications may be difficult to recognize in advance. It may also be difficult to estimate the timing of different actions, such as maintenance tasks. Because the time value of money is taken into account in life cycle costing, the timing of actions also has an effect on costs. In this phase of the life cycle, recognizing the differences between individual products, for example in the manner of using them, may be difficult. In addition, uncertainty related to increases in the prices of different cost elements could have an essential effect on life cycle cost modeling.

The first version of the model illustrates the situation as seen at the beginning of the life cycle of the case product (stage 1). No preliminary plans related to the use and maintenance of products were available and thus the amounts of activity drivers were determined on the basis of different estimations. The number of shots, which has a significant effect on total costs, is determined on the basis of the assumption that the supplier has defined a maximum number of shots and the utilization is constant during the life cycle. No other long-term planning information was expected to be available. During the project it became evident that the organizational units responsible for maintenance and product-based training were not familiar with the future use of the product. It is thus reasonable to assume that especially at the beginning of the life cycle the perception of the utilization of the product in the future had been extremely vague.

Furthermore, accumulated experience in using the product may expose different needs for product changes which are not recognized at the beginning of the life cycle. For that reason it has been assumed that the modification needs of products were not recognized at this point and that the maintenance cycles were expected to be longer than in reality. Uncertainty has been modeled in the variables describing the differences between individual products because it has been assumed that the organization had experience of the manner of using corresponding products. On the other hand, it could also be justifiable not to take into account the differences between individual products if empirical data is not available. In that case, individual products are expected to be similar to each other. The accumulation of life cycle costs as seen at the beginning of the life cycle (stage 1) is illustrated in the upper part of Figure 5, which presents life cycle costs in three different stages of product life at the individual product level. Note that the six stages in the figure do not stand for any specific decision points but represent merely the continuum of time. Similarly, it is shown in Figure 2 that the product life has been divided into periods for the sake of activity cost assignment. In this way, the possible range of costs and related uncertainty can be seen as a function of time. The centerline of the plot represents the mean value of life cycle costs and the darkest area illustrates one standard deviation above and below the



**Figure 5.**  
Evolving cost image  
during the life cycle

mean. The light grey area illustrates the most likely 90 percent of the possible values. Thus, the most extreme 10 percent of the values are excluded from the area illustrated in the plot. The incurred costs, the comparison between the incurred and estimated costs, and the estimated future costs are presented in the tables in Figure 5.

The values of the different variables and related uncertainty can be updated on the basis of the empirical data accumulating during the life cycle. When the amount of empirical data increases and the length of the forecasting period becomes shorter, the uncertainty related to variables of the model can increase or decrease, as a result of which the range of the possible outcomes of the model increases or decreases. Typically, the estimates of the length of the product's life cycle and the way of using the product will become more accurate during the life cycle, which reduces the amount of uncertainty in the modeling.

The second version of the model illustrates the accumulation of life cycle costs as seen after one fifth of product life (stage 2). Thanks to the obtained empirical data, it was possible to update the values of the different variables and related uncertainty. On the basis of the empirical data, it was possible to observe that for example the amount of product use differs between individual products. However, the amount of activity drivers regarding future periods was determined on the basis of relatively rough assumptions because detailed plans related to the use and maintenance of products were not yet available. It was assumed that in this phase of the life cycle the modernization needs of the product were identified, but the realistic length of the maintenance cycle was not exactly known. These assumptions were taken into account in the modeling. In addition, the values of the variables describing the differences between individual products were updated on the basis of the empirical data and it was assumed that the differences will continue to be similar in the future.

The accumulation of life cycle costs is described from the perspective of stage 2 (after one-fifth of product life) in the middle part of Figure 5. The range of incurred costs proved to be 16.4 percent smaller compared to the estimation done at the beginning of the life cycle. However, the mode of incurred costs was 14.6 percent greater compared to the estimation done at the beginning of the life cycle. The main reason for this is that the actual use of the case product was more frequent than was expected at the beginning of the life cycle. Compared to the results of the modeling done at the beginning of the life cycle, the range of the estimated total life cycle costs is 2.3 percent smaller. As one can see from Figure 5, also the incurred costs include uncertainty. Ideally, the incurred costs could be illustrated using a single line without any confidence limits, showing that the costs are known for sure. In this case, however, the uncertainty remains for two main reasons:

- (1) the aforementioned sampling of products and non-coverage of the whole fleet; and
- (2) inability to determine the past costs with absolute certainty since there was no such cost database available.

The situation at the time of the project (stage 3) is illustrated in the third version of the model. At that time, compared to the previous two stages, a longer cost history was available (still containing deficiencies referred to earlier). The user organization believes that the case product will still be in use for quite a long time and thus the

future costs were also taken into account in the third version of the model. Because plans related to the use and maintenance of the case product were not available even at the time of the project, future costs were estimated on the basis of both historical development and approximations. The lower part of Figure 5 illustrates the accumulation of costs as seen at the time of the project. Compared to the results of the modeling done at the beginning of the life cycle, the range of incurred costs is 17.5 percent smaller. On the other hand, the total life cycle costs are lower compared to the results of the previous modeling. The reason for this is that the actual use of the case product has been less frequent than expected on the basis of use in the initial stages of the life cycle. Regarding future costs, the range of possible costs seems to decrease when the amount of historically collected data increases. For example, the range of the estimated total life cycle costs was 8.2 percent smaller compared to the estimates done after one-fifth of product life (stage 2).

Overall, in this case, one can observe that despite the accumulation of information and historical data, the uncertainty related to life cycle costs does not decrease to a negligible level. In the case of future costs, uncertainty remains due to the fact that there is a lack of detailed and/or diffused long-term planning information in the organization. In addition, the actual use of the product has been so varied that it is very difficult to establish any clear trends concerning its future. Also, the product is barely in the middle of its expected life cycle, which means that a lot can happen during the times ahead. Concerning the past costs, the reasons for uncertainty have been discussed earlier.

#### 4. Findings and discussion

On the theoretical side, it was argued that the concept of cost image – continuous or up-to-date perception of past, present, and future costs – is a fair description of what life cycle costing would ideally provide when applied thoroughly. The concept of cost image was associated with the idea that the characteristics of LCC as well as the methods applied and the results obtained by LCC will inherently evolve during product life. That is, “LCC” at the beginning of product life is something quite different compared with “LCC” at the end. The paper highlighted the challenges related to collecting adequate data and practicing long-term cost management in an uncertain environment. Empirical material was collected through a case study in the Finnish Defence Forces, which is facing increasing challenges to control the life cycle costs of their material.

The case produced several interesting findings. First, long-term cost management is indeed able to produce real surprises even for the people inside the organization that have a long history with the product in question. The long-term cost breakdown structure of the case product proved to be something other than was expected on the basis of prior gut feeling. This is largely due to the fact that there is no single part of the organization that is responsible for collecting and aggregating the data related to this product. Hence, there is no one that will eventually see the “big picture” either on the basis of experience or information systems. In a feedback session after the study, the representatives of the organization admitted that their long-term cost consciousness is weak at product level and that life cycle costing is a potential tool



for improving the situation. An officer responsible for managing maintenance activities of the product commented:

This [case study] shows that we must increasingly focus on the life cycle costs of our material. Otherwise we just don't know where we are.

Second, the case shows that developing life cycle costing in an organization is a long-term project in itself. Starting from a modest level, which was the case in the FDF, means that one cannot immediately expect a full LCC application that is able to totally transform poor cost consciousness into complete understanding of long-term costs. Instead, a continuous improvement strategy should be adopted. Only by actually practicing long-term cost accounting and management can an organization learn more about the behavior of product cost. That is the very reason behind the importance of collecting product cost history data. The investigation of a case product, such as was carried out, can highlight the idea of LCC and produce some positive effects, but more fundamental issues, such as proper data collection and analysis on an operational level, cannot be taken care of by means of a separate project. This became very clear from the discussion in the feedback session.

Third, the relevant supporting methods associated with LCC seem to be truly time-dependent. However, the most important methods cannot perhaps be found inside the boundaries of management accounting. For useful life cycle costing at the beginning of product life, the most important factor seems to be a realistic product utilization plan. There is no such thing as an accurate cost estimate without an accurate description of product future use. The utilization plan should not only be constructed at the beginning but also updated during product life if any need for changes occurs. An updated utilization plan complements the other important component of LCC: the collection of product-specific data during product life, which is a necessary but not sufficient precondition for sharpening life cycle costing. The interviews carried out during the study show that cost estimates are seen as the single most important component of LCC (cost image) but that reliable tracking data is also of great value. Estimations always contain some uncertainty, which means that quantification of uncertainty is especially needed when the prevailing emphasis of LCC is on cost estimation.

Fourth, if data in sufficient quantity and of sufficient quality is collected during a product's life cycle, it should be possible to determine at the end of the life cycle the actual total life cycle costs, the accumulation of activity costs, and the activity consumption during the phases of life (including cost breakdown by activities or by other relevant costing objects). That is, it should be possible to produce a final closing of accounts with respect to a particular product with negligible uncertainty. On the other hand, as the case shows, depending on the accuracy and the exhaustiveness of historical data, the uncertainty related to the incurred costs may have to be modeled also at the end of a life cycle. Potential practical reasons for this include short life cycles of information systems (shorter than those of products in question), the cost of collecting certain data concerning all activities, or the cost of collecting data covering the entire product fleet in the organization. As always in cost management, it is important to recognize also in LCC that the cost of producing the data must not exceed its value.

Finally, both challenges and possibilities in connection with LCC were identified in the case study. There is no doubt that challenges related, for example, to data gathering can be overcome if there is enough will. However, perhaps the most fundamental question is what the primary motivation of the FDF would be for using LCC. Would it be an effective planning device as suggested for firms with products early in their life cycle? Probably yes, because it is beginning to be acknowledged concerning many products in the FDF that although the organization can afford to buy a product, it is another question whether there is enough funding for its effective utilization. Even rough estimates at the beginning of a product's life could be sufficient to show whether the considered product is feasible for the FDF. On the other hand, LCC could be a planning device for selecting the most suitable technology rather than for choosing the most suitable supplier or product. The uncertainties inherent in estimating the cost of alternative products make it perhaps too difficult to reliably argue supplier selection on the basis of self-made LCC calculations. That is, the differences between the average cost effects of alternative products may be small compared with the uncertainty attached to these estimates. If suppliers were willing to guarantee a certain LCC level, the situation would obviously be different. In those circumstances, LCC could also be a tool for operational purchasing – not just for strategic planning.

LCC could also be a tool for control in the FDF. By practicing systematic life cycle costing, it would be possible to show the cost effectiveness of certain technologies in the long run in real circumstances and to establish a financial reference point against which it would be possible to reflect also the value (that is the performance of the products with respect to the objectives of the organization) that is achieved by using a certain technology. In that sense, continuous life cycle costing and building a long-term cost image of a product would eventually enable good timing of decisions related to the acquisition, disposal, or updating of the material, taking into account the continuously changing ratio of cost and value.

Concerning the limitations of this study, it should be admitted that a case study, which is to a great extent based on the cost analysis of one particular product, cannot provide an analysis of all the potential or cover all the perspectives and consequences related to comprehensive use of life cycle costing in an organization and go into all the relevant challenges connected with practicing LCC in an uncertain environment. However, the paper shows that the implementation of LCC is feasible even in uncertain environments and that LCC may be a good tool in attempting to decrease the uncertainty once it has been quantified.

To us it seems clear that the organizational context always affects the manner of implementation of LCC, which means that our observations and conclusions should not be applied straightforwardly to some other quite different organization. However, if the time frames of material management, the level of available data, and the general cost management concerns were similar to those in the case described, the modeling principles and cost management framework (cost image-thinking) should be applicable without major adjustments. The least that we can say about the FDF two years after the project is that they are continuing their journey toward life cycle cost consciousness using the ideas present in the described model and the cost management framework.



The actual developed model is not in operational use, but the activity-based modeling principle and life cycle orientation are.

#### Note

1. Similar holistic approaches include, for example, the total cost of ownership concept (TCO) (Ellram, 1995; Wouters *et al.*, 2005). It is not, however, within the scope of this paper to discuss the potential differences between these approaches.

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### **ARTICLE III**

Lindholm, A., Laine, T. & Suomala, P. (2017)

The potential of management accounting and control in global operations:  
Profitability-driven service business development

*Journal of Service Theory and Practice*

Vol. 27, No. 2, pp. 496-514

# REGULAR PAPER

## The potential of management accounting and control in global operations

### Profitability-driven service business development

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#### Abstract

**Purpose** – The purpose of this paper is to identify the financial potential of new service businesses in the context of a global machinery manufacturer. The objective is to examine the supportive role of management accounting (MA) and control in service business development, which has not been empirically examined previously.

**Design/methodology/approach** – The paper takes advantage of an interventionist case study at a global machinery manufacturer and is empirically based on a comprehensive examination of the service business potential in the selected product category in different market areas. The researchers were actively involved in the accounting development activities underlying this paper.

**Findings** – The results suggest that the development of a global service business is necessary to build on market area characteristics. An analysis should combine financial information and equipment fleet information across product lines and organizational units.

**Research limitations/implications** – MA and control practices tend to require significant development to actually support the process of identifying and capturing the service business potentials. As the findings are limited to one case environment, further studies should address the longitudinal evolution of MA and control, and the choice and utilization of different performance measures, in similar contexts.

**Practical implications** – The paper provides managerial insights on how to utilize MA information and proposes ideas for performance indicators.

**Originality/value** – The process examined in this paper responds to the need for tools and techniques supporting service business development. MA and control could provide a comprehensive understanding of the dynamics of service business profitability potential and support in identifying and prioritizing the possible avenues of realizing such potential.

**Keywords** Key performance indicators, Servitization, Management accounting, Management control, Industrial services

**Paper type** Research paper

#### Introduction

This paper focuses on the identification and realization of the financial potential of new service businesses in the context of a global machinery manufacturer. For companies selling industrial equipment, product sales can be seen as a way to generate long-term revenue streams through different kinds of service offerings. However, many companies find it difficult to successfully exploit the financial potential of service businesses (Gebauer *et al.*, 2005). The profitability-driven development of new service businesses, despite its rationality, represents a challenge for the management control of globally operating manufacturing companies since there is a need to obtain a comprehensive understanding of profitability at different levels and to examine how various parts of a business might better fit together to



This paper is based on the DIMECC S4 Fleet research project and the authors greatly acknowledge the financial support of the Finnish Funding Agency for Innovation. The authors want to thank the case company's valuable input, both in terms of research cooperation, and offering access to data collection. Moreover, the authors are grateful to the editor and anonymous reviewers for their insightful comments on the previous version of the paper.

improve companies' overall profitability. This study responds to the identified lack of tools and techniques for supporting service business design in manufacturing companies (Baines *et al.*, 2009). More particularly, Laine *et al.* (2012a) highlighted the need for suitable means to support the service business renewal process, from the justification and definition of the actions to the control of the gained results. Among those means, they introduced and examined different roles of management accounting (MA) within management control systems (MCSs) in different roles supporting service business development.

Globally operating organizations face particular problems in using MA and MCS to facilitate business decisions. There are challenges in managing interactions across heterogeneous local contexts at different organizational levels (Meyer *et al.*, 2011). In this context, Cruz *et al.* (2011) highlight that to achieve both local- and corporate-level objectives, local units can reshape or reconstitute the global MCSs. Additionally, the interplay between the formal and the informal domains of MA needs to be recognized in globally operating companies (Lukka, 2007). For example, formal development of accounting and control systems may sometimes be overrun by informal routines, thus adding the complexity of accounting development processes. As the structure and use of MA should continuously fit in the external environment and be in line with the current management priorities (Korhonen *et al.*, 2013), there might be a continuous need for new levels and dimensions of reporting, analysis and measurement of financial figures. For example, the business impact analysis of new service offerings may require data on the combinations of different products and service categories across the business units. In general, producing the right MA information is ambiguous since the financial reporting lines, organizational structure and different accounting practices across organizational units may not support the structure of target setting and the nature of the business objectives.

In the context of machinery manufacturers, substantial revenues can be generated from a large installed base of products with long lifecycles (e.g. Gebauer *et al.*, 2005). Companies should pay attention to the link between equipment deliveries and their impact on service business sales. Moreover, to obtain an overall view of the service business potential, the financial analyses should be supplemented with equipment fleet information. Rabetino *et al.* (2015) studied the concept of lifecycle service offerings and argued that to identify profitable service solutions, there is a need to quantify their potential financial value, such as the total costs of ownership and productivity increases among customers. In turn, Grönroos and Helle (2010) discussed how to measure and share mutually created value between suppliers and customers. They pointed out that to share the value between suppliers and customers, the business partners must have access to comprehensive accounting data. However, there is little empirical evidence on how to actually produce and use financial data to support the development of service businesses in globally operating manufacturing companies (Laine *et al.*, 2012b).

Altogether, detailed examinations of approaches for steering the exploitation of the service business potential in manufacturing companies are lacking in the existing literature. Indeed, there is substantial research on how machinery manufacturers should change their operational routines to develop service businesses (Kucza and Gebauer, 2011; Neu and Brown, 2008; Brax, 2005; Oliva and Kallenberg, 2003). Several studies have also investigated the relationship between the scale of service offerings and manufacturing firms' overall profitability (Kohtamäki *et al.*, 2015; Kastalli and Van Looy, 2013; Eggert *et al.*, 2014). In addition, Cheng and Shiu (2016) examined the link between service modularity and firm performance in the service industry. However, Araujo and Spring (2006) pointed out that increasing the variety of new services often entails significant costs, and thus companies should focus more on identifying the kinds of services that customers really need. Further, according to Shulver (2005), new service development should be based on the idea of how the new offerings can resolve the problems in existing systems and processes. Despite the wide interest in the impact of industrial services on companies' overall performance

(Cheng and Shiu, 2016; Kohtamaki *et al.*, 2015), there is limited empirical evidence regarding how manufacturing companies actually plan and control their service activities to achieve more profitable businesses with the help of MA (Laine *et al.*, 2012a; Araujo and Spring, 2006). In this context, the challenges arising from the multidimensional organizational structure in MA practices have not gained much attention.

The objective of this paper is to examine the supportive role of MA and control in service business development, which has not yet been empirically examined. The paper seeks to respond to the following research questions:

- RQ1. How can service business potential be understood through MA information and performance indicators?
- RQ2. How can service business development activities be selected and prioritized with the help of financial information?

The paper takes advantage of an interventionist case study at a global machinery manufacturer and is empirically based on a comprehensive examination of the service business potential in the selected product category, featuring different individual product types, different market areas and different reporting practices. The researchers were actively involved in the entire process of accounting development underlying this paper. The contribution of the paper lies in the identification of the challenges in creating supportive management control practices and, more importantly, in the detailed description of overcoming these challenges in a real-life case. The paper is organized as follows. First, the literature review serves as the background of the empirical study, combining the findings on identifying and overcoming the challenges of MA and control in globally operating companies with the existing service business development and servitization literature. The third section presents the setting and findings of the empirical study. The implications of the findings are discussed and concluding remarks are presented in the final section.

### Literature review

#### *Management control frames new service business development activities*

There are several definitions and classifications of MCSs, tools and practices (e.g. Berry *et al.*, 2009; Tessier and Otley, 2012). Chenhall (2003) pointed out that the terms MA, management accounting systems, MCSs and organizational controls are sometimes used interchangeably, even though they are different concepts with different meanings. To simplify, management controls include all the devices and systems that managers use to guide the behavior and decisions of their employees to ensure that they are consistent with the organization's goals and strategies (Malmi and Brown, 2008; Mundy, 2010). In this context, a goal refers to things that an organization wishes to achieve in a given performance area (markets, products, personnel, financial results) (Flamholtz, 1983). Malmi and Brown (2008) stated that management controls comprise all the rules, practices, values and other activities management puts in place to direct employee behavior, and if these are complete systems, they should be called MCSs. In management control, the focus is not only on the provision of formal financially quantifiable data but also on assisting managerial decision-making with a broad scope of information related to, for example, markets, customers and production processes (Chenhall, 2003).

There are several MCS peculiarities that need to be addressed in globally operating companies with multidimensional organizational hierarchy. According to Malmi and Brown (2008), one issue involves how the elements of management control relate to each other down the organizational levels and across organizational units. The organizational structure itself can also be seen as an example of management control (Flamholtz, 1983). Cruz *et al.* (2011) noted that in a global organization, the dispersed local units are usually compelled to adopt standard rules and procedures, which are elaborated upon at the headquarter level to increase



the visibility of the local business processes and to align them to fit the global corporate strategy. However, in the context of globally operating companies, there are challenges in managing local operations in such a way that they completely fit the company-level framework (Meyer *et al.*, 2011). Hence, Cruz *et al.* (2011) also highlighted that in the global environment, each local unit has its own specific needs and environment, and thus it may be difficult and even unnecessary to apply a homogeneous set of practices across the company.

Developing new service businesses is a strategic initiative for machinery manufacturers, and an MCS is involved in such an initiative either actively or passively. When examining the interrelationship between MCS mechanisms and strategy, Kober *et al.* (2007) found that the interactive use of MCS mechanisms helps to facilitate a change in strategy, and that MCS mechanisms change to match a change in strategy. Regarding the MCS in service business development, there are different views on how manufacturing companies should distinguish between product and service businesses (Kucza and Gebauer, 2011). For example, Oliva and Kallenberg (2003) argued that service units should be separated from product organization. On the other hand, Neu and Brown (2005) recommended that to meet complex customer needs, product and service units should be integrated. Further, Oliva and Kallenberg (2003) reported that service business development, or servitization, may change the business model and organizational concept from product oriented toward customer segment or relationship oriented. Regarding servitization, Brax (2005) noted that it is fundamental that the systems of the company are not purely transaction oriented when providing services for installed bases. Altogether, even the very basic structure of the global machinery manufacturer and thus the overall MCS is challenged by service business development. At a more detailed level, there is a potentially huge variety of different possible controls and control systems. To be effective, the production and use of financial information should fit the overall MCS and respond to the more detailed needs of servitization. Although Laine *et al.* (2012a) discussed the generic roles of MA in servitization, the actual fit between MA practices and the overall MCS in the service business development of machinery manufacturers has not been examined in the literature.

#### *MA in producing and using information for new service business development*

MA means producing and using financial information for managerial purposes. According to the Institute of Management Accountants (IMA), “Management accounting is a profession that involves partnering in management decision making, devising planning and performance management systems, and providing expertise in financial reporting and control to assist management in the formulation and implementation of an organization’s strategy” (Institute of Management Accountants, 2008, p. 1). Tillmann and Goddard (2008) defined strategic management accounting as the use of MA systems in support of strategic decision-making. Chenhall and Moers (2015) pointed out that MA has developed into MCSs comprising multiple controls and different styles of usage of MA practices. It has been suggested that MA should serve various managerial purposes, and through interactions within the organization and with its environment, the accounting information helps to facilitate strategic change in a proactive way by developing knowledge about the business environment as well as to prepare the organization for unknown future decisions and activities (Hall, 2010; Kober *et al.*, 2007).

In globally operating companies, MA may face challenges due to the fostering of multiple perspectives and the coordination of complexity and resource allocation (Dent, 1996). To organize and coordinate globally dispersed operations, global companies may force their local units to adopt standardized accounting practices (Cruz *et al.*, 2011). However, according to Chenhall (2003), formalized MA systems are ill-suited when there is a high level of interdependency between local units. In this context, Abernethy *et al.* (2004) pointed out that decentralization choices are an important determinant of MA practices.



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In addition, Lukka (2007) highlighted that the excessive standardization of MA practices in a globally operating company may not be necessary.

In general, MA practices are assumed to be based on relatively clear financial data and lines of responsibility within hierarchical structures (Chenhall and Moers, 2015). Moreover, companies' MA systems are usually strongly unidimensional, which means that they may, for example, emphasize the product line to the exclusion of inter-product synergies or regional performance to the detriment of global coordination (Dent, 1996). Thus, static and unidimensional reporting, which still prevails in many companies, limits the use of MA for supporting strategic changes such as servitization. In practice, the examination of information gathered across financial reporting lines and from multiple local units with heterogeneous accounting practices may be needed. In this regard, Tillmann and Goddard (2008) argued that the way a very diverse set of accounting information is used to make sense of strategic issues is at least as important as the specific techniques that are used. Further, Chenhall and Moers (2015) suggested that the development of strategies that focus on product and service innovations require that external factors be taken into account as well. It has also been noted that modest business consequences might not be due to the non-existence of service business potential but perhaps to the misalignment of the service business objectives with the business environment (Laine *et al.*, 2012a). Thus, service business potential needs to be examined case by case to unveil the dynamics underlying the potential profitability of those new service businesses.

To justify, define and control service business renewal actions, there may be a need to produce accounting information that is not directly available in the systems but is able to support decision-making in regard to particular new service businesses, single new services, or even single service elements within the processes. Laine *et al.* (2012a) stated that justifying servitization requires the identification of the potential values and costs of such a change from various perspectives and thus enables managers to assess servitization against other strategic alternatives. In addition, Oliva and Kallenberg (2003) noted that entering the markets implies identifying a profit opportunity within the service field and setting up the structures and processes to exploit it. Hence, justifying the need for change requires a shared understanding about the current status and aims for new directions. According to Laine *et al.* (2012a), the servitization process may affect manufacturers at the corporate level, the customer relationship and product levels, and even at the level of single elements of business processes, therefore highlighting the need to rethink the unit of analysis. Traditionally, the focus in MA is on product- and service-level analysis. The profitability implications of service business actions can be evaluated more broadly, for example, on the level of equipment fleets. In addition, the unit of analysis may be determined on the basis of the business line, business unit or on a regional basis.

MA tools and techniques for unveiling service business potential exist. As after-sales service businesses typically generate long-term revenue streams, managerial analysis and decision-making should not focus only on per-transaction profitability (e.g. Cohen and Whang, 1997). The financial potential of product-related service businesses can be highlighted with the help of the lifecycle costing (LCC) approach, which focuses on the total costs/profits that occur during a product's life (see, e.g. Asiedu and Gu, 1998). According to Wise and Baumgartner (1999), to pursue downstream opportunities, the manufacturer has to look at the value chain through the customer's eyes, examining all the activities the customer performs when using and maintaining a product throughout its lifecycle from sale to disposal. By using the LCC approach, it is possible to turn into monetary terms the future maintenance procedures, the consumption of spare parts and the need for upgrades. This is supported by Dekker *et al.* (2013), who highlighted that the demand for spare parts is often difficult to forecast only on the basis of historical data, and thus it is useful to manage and analyze the installed base data by following the lifecycle of a product.

To support managerial decision-making, the diverse consequences of a decision alternative should be translated into a single financial unit of measure (Wouters, 2002). Laine *et al.* (2012a) outlined that one aspect that guides managers in choosing a reasonable MA approach is consideration of the accounting object. The traditional role of MA is to measure and manage product and service profitability, for example, on the product category, market area or customer segment levels. However, in the case where services are embedded in the goods, identifying the profitability of separate elements becomes challenging (Gremyr *et al.*, 2010). For example, new service offerings may lead to organizational arrangements and thus highlight a need to examine the costs of business processes. In turn, when providing customers with lifecycle service offerings, manufacturers should pay attention to the cost and profit implications over a long period of time (Rabetino *et al.*, 2015). More broadly, the focus can even be on the customer's revenues. For example, the development of performance contracts may be based on the understanding of the customer's earning logic. The viewpoint of the accounting information in a given situation needs to be intentionally chosen to aid the actual decision-making.

*Key performance indicators provide more in-depth insight into particular development avenues*

Accounting information is typically scrutinized into a set of performance indicators that can be used to guide the decisions made in companies. Indeed, one important aspect of management control is performance measurement that assigns numbers to represent aspects of organizational performance and behavior (Flamholtz, 1983). According to Dossi and Patelli (2008), performance measurement is one way to manage relationships between headquarters and subsidiaries. In globally operating companies, the multidirectional flows of products, capital and knowledge among various units have an influence on the nature of planning and control (Gupta and Govindarajan, 1991). For example, Abernethy *et al.* (2004) discovered that if one division has interdependencies, for example, the focal division affects another division's performance, then the use of divisional summary measures becomes less important, and the use of company summary measures and specific divisional measures such as quality and product cost increases. This may be due to the fact that the division's unique contribution in achieving the business results could be difficult to define. However, within multinational companies, performance measurement is not only a way to report and monitor financial results but also an organizational mechanism that coordinates the behavior of local units (Dossi and Patelli, 2008).

In the service business development context, Neu and Brown (2008) argued that the implementation of a service strategy requires the revision of measurement systems. However, Kastalli *et al.* (2013) highlighted that steering product-service providers toward the successful implementation of service businesses is difficult, as companies fail to reflect the presence of service activities in their performance management systems. In turn, Shulver (2005) suggested that an effective way to measure the performance of service activities is to define the current level against the achievable level of performance and thus determine the undeployed potential. That kind of approach is applicable for measuring both the effectiveness of internal processes as well as the company's position in the markets. It could be possible to measure, for example, the invoiced service hours of the maintenance personnel in relation to the total hours. In turn, the market share in a certain region can be defined on the basis of the actually served and the total equipment fleet.

As noted earlier, an organization's structure frames the MCS, defines the distribution of accountability and responsibility, and thus has an effect on the establishment of the performance indicators. However, measurement practices should not be directly tied to an organization's structure. For example, Kastalli *et al.* (2013) highlighted that servitizing firms should explicitly acknowledge and monitor the interaction between product and service activities. In practice, that

may require combinations of financial and non-financial figures across business lines and units. What is noticeable is that performance measurement may lead to suboptimization between different organizational units and hinder the overall economic results. For example, the provision of lifecycle service offerings to industrial customers may require the involvement of several local units whose performance is reported separately, and the conflicting objectives at the subunit level prevent companies from achieving optimal results as a whole. Thus, according to Kucza and Gebauer (2011), the management's financial incentives may be based on criteria that, for example, focus on the performance of an interdependent cluster of organizational units.

#### *Synthesis of the literature*

As discussed above, many different types of management controls exist, and accounting information and performance indicators could, in many ways, support new service business development. At the same time, there are many peculiarities related to MA and control in globally operating companies, particularly in the context of servitization. Regarding service business development, not much is known about the actual utilization of MA and control. Thus, the following points were identified for consideration in the profitability management of service business in global operations:

- equipment fleet information – overall view of the business potential;
- multidimensional organizational structure – interactions across heterogeneous units (e.g. product/service) at different levels (e.g. global/local); and
- MA and control – understanding of the financial impacts at different levels (e.g. product/service category, market area, customer segment) and from different viewpoints.

In response to the research questions of the paper, MA and control with several detailed performance indicators are required to comprehensively understand the current service business and the dynamics of its profitability. The analysis of the business impact of service actions may require data on the combinations of different product and service categories across business units and market areas. In particular, information about equipment fleets is required to understand the service business potential from a given viewpoint. A key issue in global operations is how the elements of MA and control relate to each other across organizational levels and units. In addition, it may be challenging to maintain a balance in considering the global and local perspectives when determining the business structures, accounting practices, and key performance indicators.

The utilization of MA and control is not, however, limited to the analyses of the current status; rather, it should yield information for selecting and steering the actions to be taken in service business development. A detailed understanding of the dynamics of the profitability potential could even yield a prioritized list of development actions. Altogether, servitization and new service business development may require rethinking the traditional views of business and the existing control devices. These aspects have not been previously examined in the literature.

#### **Empirical findings**

##### *Research methods and materials*

The study is based on an interventionist research approach (Jönsson and Lukka, 2006; Suomala *et al.*, 2014) and conducted in close cooperation with a globally operating machinery manufacturing company. As is typical in interventionist research, active researcher participation in the real-life development project provided a good opportunity to not only observe the flow of events and reactions but also facilitate analyses and reflections

on the basis of the material produced by the researchers. As a starting point of the study, the case company is interested in expanding its spare parts business, and thus they have, for example, introduced an online application for spare parts sales. In the study, there was a practical – yet also theoretically relevant – need to figure out how the business potential could be understood through MA information and performance indicators and how to select and prioritize spare parts business development activities. Although the company would have been able to produce such MA information without the contribution of external experts, the expertise and resources provided by the researchers catalyzed the project and underlined its importance inside the company's global organization, thus building access and increasing the likelihood of relevant and interesting findings. The possibility to leverage the expertise of interventionist researchers has been consistently recognized in the prior literature (see, e.g. Suomala and Lyly-Yrjänäinen, 2011). Hence, the interventionist approach was selected because, by building on interventionist strategy, the researchers could build the access to and in-depth visibility of the ongoing business development project, and there was a clear demand for support to solve real-life problems. To achieve the research objectives, the researchers were actively involved with the entire process of accounting development and used accounting-related interventions to facilitate improvements within the case company.

As Jönsson and Lukka (2006) observed, it is crucial for the interventionist researcher to obtain a thorough understanding of the current situation in the case company from the viewpoint of the theme of the study at the outset of the empirical process. This is vital for designing interventions that best facilitate both the practical progress of the development project and the theoretical inquiry. The main interventions were financial analysis, ideas for new performance indicators and profitability scenarios. Actually, those interventions inspired many of the discussions with company people and led to the accumulation of empirical materials.

In addition to actual interventions, many other strategies were employed in gathering the data. Due to the exceptional access to rich company data, it was possible to use several methods of data collection and analysis, as illustrated in Table I. In the beginning of the research project, a meeting was conducted with the key company personnel in order to discuss and define the guidelines for the project execution. The main contact person was the business unit's spare parts manager responsible for global sales. Additionally, the business unit's director of performance and components and the manager responsible for developing the services concept at the company level were involved in the kick-off meeting.

First, a meeting was conducted with the main contact person to gain an understanding of the global business, organizational activities, challenges and future development targets. To get a comprehensive overview of the long-term evolution of the business unit's profitability, the financial figures of the equipment and service business were analyzed for a five-year period (2010-2014). An extensive amount of raw data was gathered across different reporting lines from the company's data warehouse system and modified to fit the framework of the analysis. The financial information as well as instructions for interpreting it were obtained from controllers representing two different business lines. In addition, data were collected on the delivered equipment, for example, based on the reference lists generated from the company's customer relationship management system. When the preliminary analysis of the financial figures and equipment fleet was complete, a meeting was held with the key company personnel to gain insight into managers' perceptions and development ideas. Furthermore, requirements were defined for the content and the formulation of financial information as well as the recognized control challenges.

Empirical data were also collected by interviewing the persons responsible for spare parts sales in different market areas. The interviews were semi-structured, and the questions were sent to the interviewees beforehand. As indicated in Table I, it was possible to get information regarding the characteristics of all five market areas. One of the interviews was carried out



**Table I.**  
Data collection  
methods

Date	Situation	Topic	Functions present	Data type
March 2015	Project meeting	Project planning	Spare part management, general management	Written notes
April 2015	Project meeting	Business overview	Spare part management	Written notes
April 2015	Project meeting	Financial figures	Finance, spare part management	Financial data, written notes
June 2015	Project meeting	Analysis of financial figures	Finance, spare part management	Written notes
June 2015	Project meeting	Steering of results	Spare part management, general management	Written notes
August 2015	Project meeting	Financial figures	Finance, spare part management	Financial data, written notes
August 2015	Interview	Market area characteristics	Spare part sales (market areas 3, 4, 5)	Written notes
August 2015	Interview	Market area characteristics	Spare part sales (market area 1)	Written answers
September 2015	Interview	Market area characteristics	Spare part sales (market area 2)	Written notes
September 2015	Interview	Market area characteristics	Spare part sales (market area 3)	Written notes
September 2015	Project meeting	Interview results	Spare part management, finance	Written notes
October 2015	Project meeting	Analysis of an online system	Spare part management	Written notes
November 2015	Project meeting	Steering of results	Spare part management, general management	Written notes
February 2016	Project meeting	Analysis of an online system	Spare part management	Written notes
February 2016	Project meeting	KPI measures	Spare part management	Written notes
March 2016	Project meeting	Results of the study	Spare part management, general management, spare part sales (market areas 1, 2, 3, 4, 5)	Recorded field notes

face to face with the respondent, and data were collected through written notes taken during the interview. A videoconference was held with one interviewee who had prepared a presentation to support the interview session. With another respondent, the interview was conducted by phone and supplemented with written answers sent afterwards. Yet another respondent submitted comprehensive written answers, and thus no personal interview was conducted. The themes covered in the interviews were the market area characteristics of the spare parts business, sales channels and the served equipment fleet. Additionally, the managerial possibilities and challenges related to the new online application were discussed. The findings from the interviews were presented, and targets for project completion were reviewed in a meeting held with the key company personnel.

Overall, the meetings with the business unit's spare parts manager responsible for global sales played a key role in this study, providing knowledge regarding the applicability of the outlined ideas. The ideas for new performance indicators were tested with her, and as the study progressed, this resulted in insights regarding the profitability scenarios of the online system. Finally, the findings of the project were presented and reflected upon in a global meeting with all the market area representatives and other key individuals involved in the research project. In practice, the meeting was carried out as a videoconference. Before the meeting, the findings of the project were reviewed and agreed upon by the spare parts manager responsible for global sales. Based on the project findings, there was an active discussion about how to redirect the spare parts activities to improve profitability by taking into account the characteristics of different market areas.

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*Case overview*

The case company is headquartered in Europe and has plenty of factories and offices around the world. At the moment, the company is organized around four business lines and in five geographical areas. Further, there are separate service units and regional units within the business units. In 2015, the service business generated 40 percent of the company's total revenue. However, the majority of the revenue of the business unit under study is still based on equipment sales. The company is serving hundreds of customers globally, and its own-installed base can be calculated in the hundreds of units. Typically, the company sells a spare parts package to a customer in connection with the equipment sale to ensure the proper operation of equipment during the warranty period. However, the majority of its business comes from the transactional sales of spare parts. In addition, spare parts are often included in the maintenance offerings and in long-term service agreements.

The sale of spare parts is organized by four country/sales companies located on three different continents. Differences in the responsibilities and functions of the spare parts teams lead to challenges in the higher-level management and control of the teams. One of the teams is closely tied into the maintenance function, which enables it to seek business solutions that optimize overall profitability. In one of the country/sales companies, spare parts sales are organized entirely differently than in the others, as the team is responsible for the spare parts sales of all business lines in a certain market area. Thus, they have to cope with different kinds of technical issues and require support from other spare parts teams and technicians outside the team. A characteristic of one team is that they are acting as a "hub," which means that they are a point of contact for customers, but another team takes care of the actual work. In practice, this leads to internal business transactions and complicates the management control practices. The global sales are coordinated and managed by the team located in the company's home country. Because the capital sales projects are also managed from the same local unit, they naturally have the best knowledge regarding technical issues and thus provide considerable sales support to the other spare parts teams. The problem is that beyond the existing financial reporting structure, it is not possible to generate comprehensive and consistent accounting information to steer the spare parts business activities due to the several interfaces and peculiarities. For example, the interaction between equipment deliveries and service activities does not appear within the current reporting system. In addition, there are no solid installed base data available in aggregate form to support the analysis of the business potential stemming from customers' equipment fleets.

*From a general understanding to specific profitability potentials*

To produce the necessary information for assessing the spare parts business potential of the case company, several steps had to be taken. First, the challenges of management control practices that stand in the way of developing global spare parts business activities with new earning logics and more effective procedures had to be determined. As discussed in the previous chapter, the business structures of the company were studied, and the following challenges in the management control practices were identified:

- organizational structure in which heterogeneous local units have different roles, responsibilities and accounting practices;
- financial reporting practice does not encourage interaction between machine deliveries and service activities; and
- key performance indicators do not capture the comprehensive performance of the business.

To develop a general understanding of the current profitability potentials, an analysis was first conducted on the business unit's financial figures on both the market area and

country/sales company levels. On that basis, it was possible to examine the role of equipment sales and different service elements sales in the success of the business in different market areas. Regarding this, an interesting finding was that the responsible persons in charge of the service business were not accustomed to examining equipment and service sales figures combined in the same report. They pointed out that these functions work independently from each other, and thus their efforts are not coordinated centrally.

Further, to estimate the business potential that the company has in its current equipment fleet, the financial analysis was supplemented with installed base information. The analysis of market area characteristics illustrated in Table II revealed that the business potential stemming from the equipment fleet varies significantly between the market areas. Thus, based on the analysis, it is possible to estimate whether an increase in the spare parts business profitability can be achieved primarily through sales growth or rather by reducing costs through a more cost-effective spare parts sales process.

Within Market area 1, the installed base of the company's own equipment is relatively small, and the company has quite a high market share in the spare parts business. Thus, its strategic focus has been placed on competitors' equipment, meaning that it is now serving an equipment fleet that is approximately two times its own-installed base size. It became very clear in the interviews that the company personnel are analyzing the business environment very carefully to determine the business potential of their own and their competitors' equipment.

In Market area 2, in turn, the business is largely dependent on its own-installed base and large key customers. Presumably, this is at least partly due to the fact that the spare parts team is serving all the business lines, and in their business environment analysis, the focus is on customer-specific figures. Increased profitability can likely be achieved by acquiring new customers through equipment sales and by reducing costs. It became evident in the interviews that especially in this market area, warehousing policies and procedures play a key role in making businesses successful. Thus, more effective sales processes and cost reductions through procurement process improvement and inventory management could be seen as a way to reduce costs.

As indicated in Table II, one characteristic of Market area 3 is that the equipment fleet is large and diverse. However, there is no coherent view of the fleet and the business potential stemming from the fleet in the company. It was mentioned in the interviews that the two teams responsible for sales to this particular market area do not have sufficient resources to collect and analyze the data that could support the exploitation of business potential. In this market area, the potential to increase profitability arises from the equipment fleet and from more efficient

	Market area 1	Market area 2	Market area 3	Market area 4	Market area 5
Share of the equipment sale	< 5%	15%	55%	< 5%	25%
Share of the spare part sale	30%	25%	40%	< 5%	< 5%
Equipment fleet Size	Medium	Medium	Large	Small	Medium
Characteristics	Own-installed base 50%, competitors' equipment 50%	Own-installed base within large key customers	No coherent view of the diverse equipment fleet	Fast growing own-installed base	Fast growing own-installed base
Profitability potential	Increase market share among competitors' equipment	New customers through equipment sales	Increase sales to current equipment fleet	Activate sales to current and coming equipment fleet	Activate sales to current and coming equipment fleet

**Table II.**  
Market area characteristics

ways of working. The company personnel indicated that there is considerable sales potential in the fleet that has not been fully exploited. Moreover, a high sales volume enables the company to achieve savings through more effective procedures in sales and procurement.

In Market areas 4 and 5, the equipment fleet is growing fast, and thus the potential to increase the profitability in spare parts sales stems mostly from the current and future equipment fleet. However, there are no local sales organizations, and daily business routines are handled by a spare parts team that is located geographically far away from the customers. Consequently, the business potential of the equipment fleet has not been fully exploited. It was highlighted in the interviews that in those two market areas, the teams are not selling actively but rather waiting and handling customer orders. Thus, in these market areas, a key issue is to reach the customers who have already bought equipment from them.

The final project meeting reviewing the results of the project revealed that the company personnel's perceptions of the market area characteristics were in line with the findings presented in Table II. In this context, the discussion turned toward the ability to sell spare parts for competitors' equipment. The company people highlighted that a certain kind of sales approach is needed to take the market share from competitors' equipment. In practice, they have to offer modernizations to equipment manufactured by competitors at affordable prices, with the assumption that this will lead to spare parts sales in the future. This can be linked to the issues that were highlighted regarding service business development. First, to understand the business potential, there is a need to collect information on the competitors' equipment fleet. Second, this kind of sales approach requires interactions between maintenance and spare part units. Finally, there is a need to analyze the financial impacts at different levels and from different perspectives. It was highlighted that even though that kind of sales approach has improved the company's overall profitability, it does not appear to be an attractive strategy from the maintenance function's point of view.

#### *Defining specific performance indicators to steer service business development*

The servitization initiative highlighted the need to rethink the performance measurement practices in the case company. Its current key performance indicators only reflect the performance of spare parts sales processes in terms of on-time deliveries and quotation lead times. Financial reporting, in turn, focuses on traditional units of analysis, such as product sales in market areas or the country/sales company level. In addition, when refining and validating the preliminary findings of the study with the company personnel, it became apparent that the financial performance of the market areas and country/sales companies' operations could not be analyzed directly based on data taken from the systems. Moreover, in the interviews, insights were obtained on the varying financial reporting practices and internal business transactions. Thus, to get more detailed and specific knowledge to redirect spare parts activities toward more profitable business, there was a need for the new kind of performance indicators illustrated in Table III as well as a more detailed analysis of the figures.

To identify the undeployed potential of service activities, it was suggested that the equipment fleet information be utilized when measuring the current level and potential of the spare parts business in different market areas. First, as indicated in Table III, spare parts sales were measured against the equipment fleet in different market areas. Second, the market share was defined by calculating the sales figures in contrast with the sales potential of each market area. The sales potential was estimated on the basis of the equipment fleet size and the potential sales per equipment. Potential sales per equipment, in turn, were determined based on the figures of the most successful market areas. In this way, it was possible to identify the theoretical market share for each market area. However, several challenges arose related to equipment fleet-driven measures since, at least in some market areas, the strategic focus is increasingly on competitors' equipment, and thus determining the fleet size is not unambiguous. Moreover, it was highlighted in the interviews that it is not



**Table III.**  
Ideas for new  
performance  
indicators

Performance Indicator	Formula	Unit	Level	Results
Spare parts sales per equipment	Net sales/equipment fleet size	€/equipment	Market area	Un-deployed sales potential
Market share	Net sales/sales potential derived from equipment fleet size	%	Market area	Un-deployed sales potential
Spare parts sales per employee	Net sales/sales team size	€/employee	Sales team	Cost-effectiveness
Unit costs of order processing	Personnel costs/number of transactions	€/order	Sales team	Cost-effectiveness
Customer segmentation	Customer base divided into groups based on their annual purchase volumes		Market area	Nature of business transactions

always easy to determine the original manufacturer of equipment because of the long lifecycles, including rebuilds and modifications. Despite the recognized deficiencies illustrated above, the company personnel indicated that the equipment fleet measures could provide insights into the type of actions and resources needed in different market areas.

Because the company is evaluating the business potential of new sales channels, it was necessary to measure the cost-effectiveness of the current spare parts sales activities, as described in Table III. First, it was necessary to define how much each team generates in net sales per employee. The needed data were quite unambiguously and easily available in the systems. Second, the unit costs of the current order processing system were determined by calculating the personnel costs of the spare parts teams against the number of transactions. In this case, reprocessing the data taken directly from the systems was required because there is significant sales support between the teams, which does not appear in the figures. The data on internal transactions were analyzed and supplemented with interview data to determine the yearly output and required resources of the teams. The final meeting reviewing the results of the project showed an interest among company personnel in this type of approach and revealed that they have not previously defined this kind of metric.

In addition, it seemed that the measures reflecting the customer segmentation could provide insights into the nature of business transactions as well as supporting data for channeling the sales actions. Thus, the customer base of each market area was divided into three different groups according to annual purchasing volume, as illustrated in Table III. The analysis showed that nearly the same logic applies in all market areas, meaning that a small number of customers generate most of the net sales. On the other hand, the majority of customers order only a few times each year. The company personnel indicated that a similar type of analysis was done previously for only one country/sales company. Thus, the analysis across all the country/sales companies provided them with new information about business transactions.

#### *Overcoming challenges and identifying the avenues to increase profitability*

Gaining a comprehensive understanding of the current spare parts business profitability and the characteristics of market areas with the help of new MA information and new performance indicators enabled the creation of scenarios for realizing the spare parts business potential, specifically in regard to the new online system for spare parts sales. While the online system is a channel to reach new customers and increase sales, it may also result in a more cost-effective sales process for spare parts and thus increase profitability. However, introducing the system entails significant costs in terms of importing the customer-specific information into the system. Thus, estimating the business potential of the system requires assessment of the setup costs in relation to the gained monetary benefits.

Customer-driven performance measures indicated that it might be necessary to create different kinds of content for different customer segments. For customers who are buying large amounts of spare parts, it is worth creating a purchasing system that is more sophisticated than the one for customers buying only small amounts. Thus, the cost factors of setting up systems for different customer segments were examined. It was supposed that due to the new system, the order processing practices would change, as the customers would be taking charge of activities previously performed by the company. Moreover, it can be assumed that the efficiency of order processing depends on the customer-specific content in the system. For example, customers having the most advanced information available are able to buy spare parts directly via the system. The smallest customers, in turn, may only be able to send inquiries. Thus, the unit costs of order processing for different customer segments were defined based on the current performance indicators and assessments of the effectiveness of the new processes.

The analysis of the market area characteristics and the equipment fleet-driven metrics helped in assessing the achievable monetary benefits of the system. For example, assumptions were made regarding the number of existing customers that would have access to the system in the coming years. The number of new customers that could be acquired with the new system was also estimated. The main idea was that in market areas where there is significant potential in the equipment fleet and small local sales organization, the system would probably be a channel for reaching new customers. In contrast, the areas with a high market share would benefit from the system mainly due to the more streamlined order process. In turn, the metrics of customers' business transactions were helpful when estimating the annual amounts of orders for different customer segments. Overall, the profitability scenarios of the online system would not have been possible without a thorough understanding of the current state of the profitability and potential of the equipment fleet in different market areas.

## Discussion

Although there has been wide interest in service business profitability implications (e.g. Cheng and Shiu, 2016; Kohtamaki *et al.*, 2015), the need for more detailed and systematic profitability management has been highlighted in the literature (Laine *et al.*, 2012a; Araujo and Spring, 2006). Thus, the paper provides insights into a process where MA and control practice were examined and refined in order to more comprehensively understand and capture the service business potential of global machinery manufacturers. During the process, several challenges regarding MA and control were identified and overcome, stemming from the complexity of the global operations, differences in MA practices, and the lack of accounting information from different viewpoints. This process paved the way for a more detailed understanding of the actual consequences of the selected service business development activities. Indeed, MA and control could support steering and controlling the profitability of a new service businesses, especially by providing a more comprehensive view of the business potential and identifying and prioritizing the possible avenues for realizing such potential. The profitability management of service businesses requires considering the equipment fleets, interactions in multidimensional organizations, and MA and control practices that can enhance the understanding of the financial impacts at different levels and from different viewpoints. More particularly, this paper focuses on the following research questions.

*RQ1. How can service business potential be understood through MA information and performance indicators?*

This study shows that the analysis of service business potential with the help of MA information and performance indicators may require data on the combinations of different

product and service categories across the complex global organization structures. Thus, it is suggested that MA can facilitate service business development activities through collecting and consolidating the scattered financial data. In addition, non-financial equipment fleet and customer base information is needed to gain a comprehensive understanding of the market area characteristics and service business potential from different viewpoints.

*RQ2. How can service business development activities be selected and prioritized with the help of financial information?*

The paper highlights that in global companies, the development of service business is necessary to build on country/sales company- and market area-specific financial information and performance indicators because the circumstances may substantially differ across areas, particularly in regard to the equipment fleet and customer characteristics. Hence, this paper suggests that learning from differing local contexts with the help of MA information and performance indicators is crucial when seeking avenues to increase profitability. To assess and justify the profitability potential of new business activities, a company must intimately understand its current processes and the costs behind them. In turn, metrics reflecting the customer segmentation and potential stemming from the equipment fleet could provide supporting data for channeling the business actions in different market areas.

Overall, the process examined in this paper can be used as a point of reference for profitability-driven service business development both in research and in practice. In other words, the paper responds to the academic and practical need for tools and techniques supporting service business development and servitization.

*Theoretical implications*

First, based on Dent (1996), the financial reporting structure of the case company was analyzed. Based on that analysis, it was argued that companies' MA systems still tend to emphasize product-line reporting at the expense of recognizing the synergies between equipment and service businesses. However, in turn, the servitization literature (Kastalli and Van Looy, 2013; Oliva and Kallenberg, 2003; Gebauer *et al.*, 2005) has strongly emphasized the linkage between equipment and service operations because equipment sales can be seen as a way to generate long-term revenues through different kinds of service offerings. Thus, an essential point of this paper is that to paint an overall picture of service business potential, the interactions between equipment and service activities should be acknowledged in financial reports as well as in management control. This study suggests that if the interaction does not appear within the financial reporting lines, a consolidation needs to be performed with MA information. Further, it is proposed that MA practices should be developed to more comprehensively and flexibly capture all the viewpoints that are needed to examine how various parts of a business would better fit together to improve a company's overall profitability.

In line with observations in the MA literature (Tillmann and Goddard, 2008; Lukka, 2007; Cruz *et al.*, 2009), and as a contribution to the servitization literature stream, this study indicates that MA practices in global companies are often highly complex activities, which tend to require significant development to support the servitization initiatives under specific circumstances. More specifically, there are challenges stemming from the multidimensional organizational structure and differing MA practices in local units. In fact, this study suggests that the development of a global service business must be built on an analysis combining financial information and equipment fleet information across product lines and organizational units. Thus, the paper argues that servitization highlights the need for change in various forms (see, e.g. Lukka, 2007) in MA practices, and the initiative to change is likely to come from outside the financial functions of the company. To contribute to the

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MA literature, it might be worth further studying how servitization has led to changes in the MA practices of machinery manufacturers.

This study supports previous literature (Flamholtz, 1983) that the organizational structure itself can be seen as an example of management control, highlighting that the lines of responsibilities and reporting may hinder various parts of a business from working together in a way that could improve the overall profitability of the company. Moreover, as suggested in the MA literature (Gupta and Govindarajan, 1991; Abernethy *et al.*, 2004), this study illustrates that multidirectional flows of products, capital, and knowledge among various units have an influence on the nature of control in globally operating companies. Hence, it is proposed that higher-level management and control of local units should not be based solely on figures taken from the systems if the units are heterogeneous in terms of responsibilities and accounting practices. This is in line with earlier observations (e.g. Cruz *et al.*, 2011) that the harmonization of local practices may be difficult and unnecessary in the global environment.

The literature has indicated that there is a lack of measures reflecting the market performance of companies providing products and services (Kastalli and Van Looy, 2013). One of the main messages of this paper is that machinery manufacturers could utilize equipment fleet information more comprehensively when exploring the business potential of service activities. The paper proposes that companies could assess the business potential of service actions by measuring their figures against equipment fleets. Based on the equipment fleet information, it is possible to define indicators reflecting the market share and identify the undeveloped potential of service activities (cf. Shulver, 2005). Thus, this study complements Laine *et al.*'s (2012a) suggestion that different kinds of metrics are needed in the service business renewal process, from the justification of the actions to the control of the results obtained.

Providing services requires machinery manufacturers to rethink their organizational principles, structures and processes (Oliva and Kallenberg, 2003). It has been illustrated in this study that when a customer is taking charge of activities previously performed by the manufacturer, the value chain changes (see, e.g. Brax, 2005), and the costs of the processes may also change. In addition, this study supports the previous literature (Laine *et al.*, 2012a) by demonstrating that justifying servitization requires the identification of the potential values and costs of changes from various perspectives. As highlighted by this study, manufacturing companies developing new kinds of service offerings need measures that could help them to orient their actions according to different market conditions. This is in line with the literature (Araujo and Spring, 2006; Shulver, 2005), indicating that rather than increasing the variety of new services, companies should focus more on customers' needs and using comprehensive financial analysis as a starting point for service business development.

#### *Managerial implications*

The approach presented in this paper provides managers of machinery manufacturers insight into how to overcome the challenges of MA practices that could be hindering them from gaining a comprehensive understanding of their service business potential. The paper suggests that the characteristics of equipment fleets should be considered when seeking avenues for service business development and for defining new kinds of performance indicators that could support such development. In sum, the paper highlights that the managers of global machinery manufacturing companies should take into account the overall profitability implications of development actions rather than simply focusing on their own areas of responsibility.

#### *Limitations and implications for further research*

The findings of this study are limited to one case environment with a focus on the development of new accounting and control tools. Further studies should address the



longitudinal evolution of MA and control in similar contexts. The generalizability of the findings could be enhanced by gaining evidence from more cases across different industries. However, the in-depth involvement with one case company provided a comprehensive understanding of the topic and identified the most relevant practical issues to study.

The paper suggests that one approach for measuring service business potential is to utilize equipment fleet information. However, the way to approach this matter has only been presented in general terms, and further validation of the proposed measurement method should be undertaken. Thus, further development of the performance indicators reflecting the business potential stemming from current and future equipment fleets is encouraged. Moreover, further research could consider, for example, how to exploit the LCC approach when estimating future service business potential.

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## **ARTICLE IV**

Stormi, K., Lindholm, A., Korhonen, T. & Laine, T. (2017)

RFM customer analysis for service business development: An interventionist  
case study of two machinery manufacturers

*Workshop & special issue for Journal of Management and Governance*

June 29-30, Pisa, Italy





# **RFM CUSTOMER ANALYSIS FOR SERVICE BUSINESS DEVELOPMENT: AN INTERVENTIONIST CASE STUDY OF TWO MACHINERY MANUFACTURERS**

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Part of this workshop paper has been included in an article submitted to Journal of Management and Governance

## **Abstract**

The purpose of the study is to examine how original equipment manufacturers (OEMs) can segment their spare part business customers with the help of the recency, frequency and monetary value (RFM) analysis. The research extends the RFM analysis with four industrial services specific variables and outlines similarities and differences between the industrial service context and the consumer business context in using the RFM analysis. The study contributes to the servitization literature and in particular, to management accounting supporting servitization by introducing a method to use installed base and customer information to measure and analyze business potential of an industrial machinery fleet. The study is an interventionist case study. The case companies are two large OEMs that seek business growth in the area of services.

## **Keywords**

Servitization, industrial services, installed base, business potential, management accounting, interventionist research, customer relationship management, customer segmentation

## **Introduction**

Knowing your customers is the key to success. Customers are different in many respects. In business-to-consumer (B2C) marketing, consumers' demographics, such as age and gender, are unique. Firmographics, such as turnover and industry are different among business-to-business (B2B) customers. In addition, customers' purchasing behavior varies. Customers buy different products and their transaction frequency and volume are not identical. Typically, the number of customers is so large that customer-specific marketing is difficult to implement. For this reason, companies need customer segmentation. Segmentation divides customers into smaller groups. Customers' characteristics within the groups are sufficiently similar so that the same marketing strategy is suitable for all members of the group.

This paper focuses on the methods that can increase awareness about customers and enable value-based segmentation, and thus support machinery manufacturers' industrial service sales. It is critical for an industrial firm to know the exact customers to whom it needs to focus its limited service sales resources, in order to create significant business impacts from its potential after-sales market in an effective manner. In the context of a machinery fleet, i.e. when a firm has an installed base of machinery at its customers' sites as its market, knowing the customers is particularly tempting. In this context, a firm actually can map its customers and their service consumption behavior – both potential and real.

There is already an emerging literature on creating revenue streams from after-sales services. Especially, original equipment manufacturers (OEMs) can generate substantial revenues from a large installed base of products with long lifecycles (Gebauer et al. 2005). The after-sales function is a main strategic driver for ensuring long-term revenues and customer satisfaction (Cavalieri et al. 2007). Thus, it is necessary to produce supportive financial information for selecting and prioritizing the sales activities to support daily managerial work for those working with industrial services (Hall 2010). Exact knowledge of the installed base could indeed advance, e.g. spare parts management (Wagner & Lindemann 2008).

However, there is limited empirical evidence regarding how manufacturing companies actually plan and control their service activities with the help of management accounting (Araujo & Spring 2006; Laine et al. 2012a). Actually, there are indications that management accounting practices that focus on spare part business does not exist at many companies (Wagner & Lindemann 2008). In addition, there is lack of tools and techniques for steering service business actions in manufacturing companies (Baines et al. 2009; Laine et al. 2012a). Creating supportive information for decision makers represents a challenge for many companies since information is scattered in different systems and in different forms (Lindholm et al. 2017). Quite understandably, prior research calls for new knowledge about how the emerging trend of servitization drives change in producing (Cinquini et al. 2015) and exploiting (Lindholm et al. 2017) financial information. There is a need for integrative frameworks that help managers use their machinery fleet information to govern the often-global service networks. Although research points out advancements in measuring and managing the performance of service operations (e.g., Jääskeläinen et al. 2012; Pekkola et al. 2016), research does not yet adequately cover how managers can measure, analyze and understand the service business potential of an industrial machinery fleet.

One possible solution to the problem of acquiring knowledge and understanding about the installed base and customers is the RFM analysis. The acronym stands for Recency, Frequency and Monetary value. The analysis evaluates customers based on (R) how recent their latest purchase has been, (F) how frequently the customers have made purchase, and (M) how high is the monetary value of their purchases. RFM analysis is common in the business to consumer (B2C) marketing (Verhoef et al. 2003). However, and surprisingly, examinations of the RFM analysis for supporting the service business in manufacturing companies are lacking in the existing literature. Moreover, there is not adequate knowledge of the applicability of the RFM analysis to the industrial service context. There is huge potential in combining installed base information into the customer segmentation analysis in order to understand which customers are particularly interesting for service sales – and why? For this reason, the objective of this paper is to examine the supportive role of the RFM analysis in the machinery manufacturers' industrial service sales and service business development.

This paper relies on qualitative inquiry, more particularly on an interventionist case study (Jönsson & Lukka 2007; Lukka & Suomala 2014; Suomala et al. 2014; Laine et al. 2016b). The case study is about two manufacturing companies that seek business growth in the area of services. This paper pseudonymously presents these companies as FleetCo and ProcessCo. Both companies are large, and they have decades of experience from operating in their industries. FleetCo manufactures mobile equipment and ProcessCo equipment that is stationary. These two case studies further narrow down the topic of this paper, i.e. service sales, to focus on spare part sales in particular. The results of the paper are nevertheless potentially applicable to other industrial services (such as maintenance) as well, and therefore this paper opens up numerous novel future research directions.

The contribution of the paper lies, indeed, in the detailed examination of how OEMs can segment their spare part business customers with the help of the RFM analysis. First, the paper contributes to the literature by applying the oft-consumer-business-applied RFM analysis to the context of industrial services. The results of this paper show that the RFM analysis is able to sort industrial service customers into meaningful segments. Firms can then focus service sales on these segments and hence effectively allocate service sales resources where they could be most impactful. Second, the study extends the RFM analysis by four variables: fleet size, part depth and part width, and altogether fleet service business potential. These variables are potentially transferable across contexts outside industrial services as well. Third, we present similarities and differences between the industrial service context and the consumer business context in using the RFM analysis. In particular, we show that that the R, F and M variables may have a different

interpretation in business-to-business (B2B) than in B2C marketing. More broadly, the findings of this paper encourage further examinations from the management accounting and governance perspectives. Especially, the paper encourages the servitization literature to find ways to utilize accounting information, especially customer and installed base information.

The paper is structured as follows. First, the paper looks at prior studies on profitability management in services and customer segmentation and especially RFM analysis. Based on these literatures, the paper builds up a tentative framework. Then a methodology section describes our data set and analysis methods. The empirical part complements the tentative framework by the results of the interventionist case studies and FleetCo and ProcessCo. Finally, a section containing the discussion and conclusions reflects upon the empirical findings and prior literature and presents our directions for further research.

## **Literature review**

### *Profitability management in services*

Regarding servitization, there is not only need for new capabilities and metrics but also the emphasis of the business model changes from transaction-to relationship-based (Oliva & Kallenberg 2003). Because after-sales service businesses typically generate long-term revenue streams, managerial analysis and decision-making should not focus only on per-transaction profitability (e.g., Cohen & Whang 1997). Thus, in addition to product- and service-level analysis, the financial implication of service business actions can be evaluated more broadly. For example, Laine et al. (2012a) pointed that the servitization process may highlight the need to rethink the unit of analysis in management accounting, and information regarding different units of analysis can be used for justifying, defining and controlling the required/desired changes due to servitization.

More particularly, as long-term customer relationships is one clear aim set for servitization (see e.g., Penttinen & Palmer 2007), the nature of the new kinds of customer relationships needs to be more thoroughly captured by the management accounting analyses. It is noteworthy that servitization provides an increased need for considering the profitability of customer companies simultaneously with the profitability of manufacturing companies (Laine et al. 2012b). Lindholm et al. (2017) recently suggested new performance indicators related to the machinery fleet at the customers and their after-sales service needs (from the customer's viewpoint) and potential (from the manufacturing company's perspective). Similarly, Korhonen et al. (2016) examined the possibilities to forecast customer behavior by extended awareness about the customers and their buying behavior. Still, there is a lot of potential in better (and more proactively) understanding the customers' service business needs that would best fit a manufacturing company's offering (Anderson & Narus 2003). Especially, there is a need for better understanding the design and use of the potential tools and techniques that could actually help the manufacturing companies to take the required steps towards the long-term, profitable customer relationships within servitization.

It is noteworthy that the design and use of the tools that would be beneficial in servitization should also fit in the decision-making processes and wider organizational context of manufacturing companies. In the servitization literature, there are mixed results regarding the benefits of centralized and decentralized service organizations (see e.g., Neu & Brown 2005; Gebauer et al. 2005). Indeed, the roles and responsibilities of different managers may vary from a narrow product category to a broad spectrum of service offerings, across business units and regional business areas (Lindholm et al. 2017). Thus, the decisions regarding particular customer relationships based on the extended customer awareness may not be taken straightforwardly. Moreover, different functions, in general, have different viewpoints to the new business phenomena, areas and offerings (see e.g., Laine et al. 2016a; Laine et al. 2016b). Therefore, increasing customer awareness needs to be a joint activity of several functional stakeholders, such as R&D, service management, financial department, key account management etc. Lindholm et al. (2017) further reminded about the holistic understanding of the servitization initiative and its

implications across business units and functions in manufacturing companies; the authors, therefore, recommended rethinking of financial metrics and their use among the service business development stakeholders.

Altogether, the research gap of the paper stems from (1) the need for more thoroughly understanding the useful units of analysis in increasing awareness about customers within servitization, (2) choosing the useful ways to use the extended financial information, and (3) from sharing such information among the relevant parties involved across traditional business units and functions.

### *Customer base analysis*

Customer relationship management (CRM) refers to all actions that companies take to enhance existing or future customer relationships for ultimately driving sales and profitability growth (Kumar 2010). CRM is a combination of people, processes and technology (Chen and Popovich, 2003). Technology comprises customer data and data processing: What type of customer data should companies collect and how companies turn customer data into information to support sales. CRM can have many objectives. It can focus on acquisition of new customers, recovering lost customers, customer retention or cross- and up-selling (Reimer & Becker 2015). Cross-selling is the action of selling various types of products and services to existing customers, i.e. to expand the customer relationship width. Up-selling is repeated sales of the initially purchased product in greater quantities or higher price segments, i.e. to increase relationship depth (Reimer & Becker 2015).

Companies can collect a range of data about customers (Reimer & Becker 2015). In the B2C marketing, customer personal data, such as age, gender, education and income, give companies valuable information about their customers. In the B2B marketing, customer's key figures, such as turnover, profitability, number of employees and industry help companies to understand their customers better. Action data covers data about actions that company has done to acquire new customers or to enhance existing customer relationships (Reimer & Becker 2015). For example, a company can maintain a relationship with the customer by email, mail or internet contacts (Direct marketing actions). Finally, reaction data reveals how customers respond to company's activities (Reimer & Becker 2015). Customer satisfaction index measures the satisfaction of customers. However, customer's purchase history is the most relevant information: What products and services the customer has purchased, how many transactions the customer has made, what is the monetary value of customer purchases.

Companies have a variety of methods available for processing customer data and dividing customers into meaningful segments. Customer profitability analysis (CPA) allocates past revenues and costs to customer as precisely as possible. Sophisticated cost allocation methods such as activity-based costing (ABC) (Smith & Dikolli 1995; van Raaij et al. 2003) and time-driven activity-based costing (TDABC) (Dalci et al. 2010) help to allocate also direct overhead costs, such as marketing, post-sales support and delivery costs, to customers. Based on CPA, companies can divide their customers into profitability segments and actually increase the current and future profitability of all customers in the company's customer portfolio (Zeithaml et al. 2001).

CPA is a retrospective approach since it measures costs and revenues per customer in a specific accounting period in the past (Holm et al. 2012). However, truthful allocation of costs afterwards is often challenging, and past revenues and costs are not guarantee of future profits. Customer lifetime value (CLV) is another possible basis for segmentation. CLV is the present value of the customer's future profits. CLV is a prospective approach since it predicts future customer behavior (Holm et al. 2012). Literature covers numerous CLV models in various contexts and for

different purposes (e.g. Ferrentino et al. 2016; Fader and Hardie 2009; Gupta et al. 2006; Rust et al. 2011).

Many CLV models predict customers' future profits with remarkable accuracy. However, the implementation of CLV models requires often expertise in statistics and special software. In addition, quite often, simple heuristics perform at least as well as stochastic CLV models (Wübben & Wangenheim 2008; Goldstein & Gigerenzer 2009; Huang 2012). It is therefore not surprising that many managers use rule of thumb heuristics-based decision making and customer segmentation (Persson & Ryals 2014). RFM analysis is a simple, easy to understand and widely used marketing technique (Verhoef et al. 2003). RFM analysis divides customers into segments based on three variables that describe customers' past buying behavior: 1. Recency, the most recent purchase date 2. Frequency, the number of transactions customer made during the period (often one year) 3. Monetary value, the total or average sales attributed to the customer during the period. Customers who have done frequent high-volume transactions recently presumably respond positively to marketing activities and their value for the company is higher.

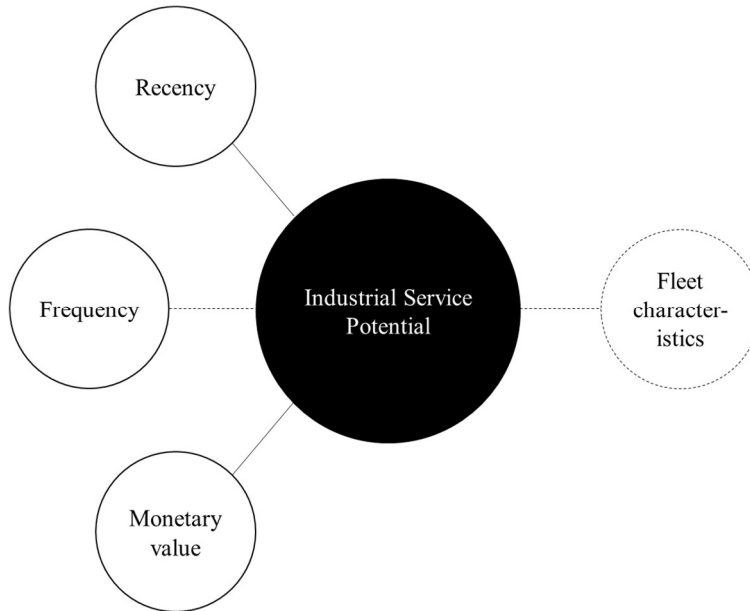
From the perspective of implementation, a company divides each variable (R, F and M) into suitable number of categories, typically 3 or 5. As an example, the customer belongs to the R category 3 if time since the most recent transaction is less than one month, to the R category 2 if time since the last transaction is between one to three months and to the recency category 1 if the customer has not been active in the last three months. Respectively, a company defines meaningful thresholds for each of the F and M categories. The division of the variables into three categories leads to  $3^3 = 27$  customer segments. As an example, 3x3x3 customers are the most important customers on basis of all three variables: They have made recent purchases and their transaction frequency and monetary value are high. Customers in the 1x3x3 segment are past major customers: Their frequency and monetary value are high but the elapsed time from the most recent purchase is alarmingly long.

The above-described customer segmentation based on RFM variables is simple and easy to implement. Alternatively, companies can use more sophisticated analytics for customer clustering based on their RFM values. Sequential pattern mining (SPM) based segmentation helps managers to identify possible changes in customers' purchasing patterns over time (Chen et al. 2009). Chen et al. (2012) use k-means clustering algorithm and decision tree induction for customer segmentation based on their RFM values.

#### *Tentative framework*

Oliva and Kallenberg (2003) identified advanced service infusion stage, where manufacturing company may take over part of the maintenance and production operations of the customer. Already before reaching this stage, the manufacturing company needs to know quite a bit about the machinery fleet at the customer in order to design and enact maintenance operations in a proper way. In this vein, Holmström et al. (2010) concluded that the manufacturing company needs visibility to the customers operations one-step beyond (deeper than) the scope of its service offering. Therefore, to be able to provide spare parts and maintenance for the customers manufacturing company needs to know, the location, scope and characteristics of the use of the machinery. The study of Dekker et al. (2013) indicated that information about customers' equipment could support, for example, in planning for responsive spare part logistics services. Rabetino et al. (In press) highlighted that servitization requires better customer knowledge and companies can collect information to understand how the installed base performs and to determine how customers use the sold equipment. In all, the knowledge of customer data is a prerequisite for active spare part marketing (Wagner & Lindemann 2008). Thus, it is fair to say that this knowledge could be in one way or another available also to supplement the RFM analysis and related implications.

Figure 1 illustrates the tentative framework of the RFM analysis. The traditional RFM analysis is based on R, F and M variables describing customer's buying behavior. The tentative framework adds special variables describing customer's installed base and after-sales consumption (fleet characteristics) to the traditional RFM analysis. The traditional RFM analysis and fleet characteristics together reveal the industrial service potential.



**Figure 1.** *The tentative framework of the RFM analysis.*

FleetCo's and ProcessCo's case studies are next used in supplementing this tentative framework. In the following section, we will go in more detail in how we collected our data in these companies.

### **Methodology**

This paper relies on two interventionist case studies (Jönsson and Lukka 2006; Suomala et al. 2014) conducted in close cooperation with globally operating machinery manufacturing companies. Both companies have realized that profitability can be enhanced by adopting customer centric logic in after sales operations and they wanted to develop methods and tools for customer base analysis and segmentation. Thus, the interventionist approach was selected because, the researchers could build the access to and in-depth visibility of the ongoing business development projects, and there was a clear demand for support to solve real-life problems. The researchers were actively involved with the entire development process and used accounting-related interventions to facilitate improvements within the case companies. The researchers could be seen as participants who were interested in developing the companies' service business but were free of any sort of company internal policies:

“The fact that the university was part of this [development work] and we have the scientific research aspect here. I think it shifts the communication into a neutral tone.” (Analytics director, FleetCo)

The main interventions in both studies were applications of the RFM analysis. Jönsson and Lukka (2006) highlighted that it is crucial to obtain a thorough understanding of the current situation in the case company at the outset of the interventionist research process. In both case companies, the studies presented in this paper were preceded by comprehensive financial analyses of the spare part sales operations. In addition to actual interventions, data were collected in interviews, company data analysis, meeting facilitation/participation/observation, and in email and phone call

exchange. Actually, many of the discussions with company people were inspired by those interventions and led to the accumulation of empirical materials.

Table 1 illustrates data collection process at FleetCo. The implemented RFM analysis is part of a three-year research project that began in early 2015. Before the RFM analysis, the project conducted a market area analysis and created an industrial service demand forecast model. Interviewees and regular meetings were the main data collection methods. Several employees of FleetCo took part in the project. However, the Analytics director and the Service development manager had particularly important role in conducting the RFM analysis (Table 1).

**Table 1.** *Data collection at FleetCo.*

<i>Theme of meeting</i>	<i>Attendants</i>	<i>Date</i>
Project kick-off and market area analysis 1	Service development manager	2015-02-13
Benchmarking from another company	Service development manager, Product manager, Service training, Service process management, Life cycle services, Information technology, Maintenance operations	2015-02-16
Profitability analysis planning	Service development manager, Product manager	2015-03-05
Accounting fact construction	Service development manager, Product manager	2015-05-22
Market area analysis 2	Product manager, Market area responsible	2015-06-12
Market area analysis 2 reflection	Service development manager, Product manager	2015-08-11
Planning market area analysis 3	Service development manager	2016-01-11
Research project steering group meeting	Service development manager	2016-01-20
Information sharing for new people around the project	Research manager, Industrial designer	2016-01-29
Overview of the installed base and sales data	Development manager, Analytics director	2016-02-04
Market area analysis 3	Service development manager, Market area responsible	2016-03-08
Services demand forecast model	Development manager, Analytics director	2016-03-30
Market area analysis reflection 3	Service development manager	2016-05-23
Spare parts demand forecast model	Analytics director	2016-10-13
Service demand forecasting	Service development manager, Analytics director	2016-10-26
Service demand forecasting	Analytics director	2016-11-29
Service demand forecasting reflection	Analytics director	2016-11-30
Management accounting tool development reflection	Service development manager, Analytics director, Research manager	2016-12-19
Management accounting tool development reflection	Service development manager, Analytics director, Research manager	2017-02-16

Data collection at ProcessCo is illustrated in Table 2. Actually, this study furthers previous interventionist study in the case company conducted between 2015-2016. In the previous study, the spare part business profitability and market area characteristics were analyzed. As illustrated in Table 2 the data was collected through project meetings (12) and interviews (4). The main informants spare part manager and spare part experts in different market areas. In addition, the spare part director and general manager defined the guidelines for development as the project progressed.



Regarding this study, the project execution was planned with the spare part manager responsible for global sales. Following the earlier development work at ProcessCo there was a need to examine the customer base more closely. Thus, it was decided to utilize the same customer segmentation approach that was developed in FleetCo case. As described in Table 2, a couple of meetings were held with spare part manager and spare part expert to test the applicability of the outlined ideas and to define the content of information. The RFM analysis was created based on an extensive amount of spare part sales data gathered from company's data warehouse system. Finally, the RFM analysis was presented and reflected upon in a meeting with the spare part director, spare part manager and a group of spare part experts to gain insights into company people perceptions and development ideas.

**Table 2.** Data collection at ProcessCo.

<i>Theme of meeting</i>	<i>Attendants</i>	<i>Date</i>
Profitability analysis, fleet and market area characteristics (16 meetings)	Spare part director, Spare part manager, Spare part experts, Controllers, General managers	2015-2016
Project further steps	Spare part manager	06-10-2017
Customer analysis planning	Spare part manager, Controller, Spare part expert	07-11-2016
Customer analysis tool development reflection	Spare part manager, Spare part expert	02-12-2016
Customer analysis tool development reflection	Spare part manager, Spare part expert	16-12-2016
Research project steering group meeting	Spare part manager	17-01-2017
RFM tool review & further steps	Spare part director, Spare part manager, 6 spare part experts	17-02-2017

## **Empirical findings from the interventionist case studies**

### *Overview of the case study environments*

*FleetCo* is a large industrial OEM that operates on six continents and is headquartered in Europe. *FleetCo* has two main capital product segments. The company provides a wide range of industrial services to serve its installed base and customers. These services represent more than half of *FleetCo*'s turnover and they encompass everything needed to keep the installed base in action: installation, spare parts and maintenance. *FleetCo* has tens of thousands of different spare parts. The company divides spare parts into two main categories: normal spare parts and wear parts. Wear parts are spare parts that will wear evenly when the device is in use. In total, spare parts account for over a half of the after-sales. The company uses several distribution centers to deliver spare parts globally.

*FleetCo* has thousands of industrial customers around the world. In some market areas, the role of dealers is significant. Customers range in size from one-man business to globally operating industrial companies. The installed base covers thousands of pieces of equipment. Currently, *FleetCo* segments customers based on their geographic location and industry type. *FleetCo* has comprehensive financial reporting practices. The company has a separate analytics department that gathers and analyses information about sales and installed base. Installed base database contains multiple types of relevant information about sold pieces of capital equipment: initial owner, type, installation date, mode of operation and location. The oldest pieces of equipment are over 40 years old. The sales database, in turn, contains comprehensive order information: customer, sold items and their quantity and unit price (in case of spare parts). Based on the

information, FleetCo produces reports of actual sales, prepares sales forecasts and calculates customers' potential based on their installed base.

Overall, FleetCo's financial reporting practices are good. However, the company has identified areas for improvement. First, the analytics should produce sales forecasts. In particular, forecasting the demand for spare parts is important since too big inventory runs the risk of obsolescence whereas too little inventory runs the risk of losing sales and customers. Second, the company should identify customers that are lost or are in danger of losing as soon as possible. Third, analytics should recognize the customer's abnormal consumption of spare parts. Abnormality may be caused by, for example, that a customer buys some spare parts from FleetCo's competitors. In addition, improper use of a piece of equipment can cause a particularly high consumption of spare parts. Identified abnormalities, in turn, are useful selling points.

*ProcessCo* has plenty of factories and offices around the world and is headquartered in Europe. Their business is organized around four business lines and in five geographical market areas. Regarding the selected product category under study the company is serving hundreds of customers globally, and its own installed base is a few hundred units. The majority of its spare part business comes from the transactional sales. Other channels for spare part sales are maintenance offerings and long-term service agreements. Daily spare part activities are handled through four country/sales companies located on around the world. The sales teams are quite different in terms of roles and responsibilities. This leads to, for example, internal business transactions and complicates the management control practices. The unit that manages the machinery sales projects coordinates also the global spare part sales. Hence, they have the best technical knowledge and provide considerable sales support to the other spare parts teams.

Actually, the financial reporting practice of *ProcessCo* does not encourage the interaction between machine deliveries and service activities. According to company people, they are not accustomed to examine the financial figures of machinery and spare part sales combined in the same report because the efforts of these functions are not coordinated centrally. On the other hand, in the company, there is no coherent installed base data available that could support the analysis of the business potential stemming from customers' equipment fleets. More particularly, the sales teams are lacking resources to collect and analyze the customer data that could support the exploitation of business potential. Thus, there is a clear need to create a practical and simple method/tool that can increase awareness about customers and enable value-based segmentation.

Altogether, FleetCo and *ProcessCo* are interested where their installed base is located, how it is used, and are they purchasing services in proportion to their expectable service consumption. To build such understandings, FleetCo and *ProcessCo* need to gather installed base data on each installed piece of machinery, thus accumulating data about each customer in total, each country in total, and the whole market in total.

#### *RFM analysis at FleetCo*

The research project began in early 2015 (Table 1). A comprehensive market area analysis for two countries was the first outcome March 2015 – May 2016 (Table 1). After this, the next step was a statistical model that forecasts sales for industrial services.

In summer 2016, the research project was at a turning point. What to do next? How to promote, in particular, spare parts and industrial service sales? FleetCo had recently reduced its sales resources and was interested in how they could support service sales. FleetCo's Analytics director had two ideas: First, the analysis should identify lost customers and customers that FleetCo is in danger of losing. Second, the analysis should identify customers who buy spare parts differently compared to other customers with a similar installed base. These customers may buy some spare parts from competitors or they might use their installed base in an atypical way. As a concrete

action, sales should immediately contact the lost customers, dig into causes behind the sales drop and win the customers back. A typical spare parts consumption, in turn, reveals where sales should focus their efforts.

In the literature, there are several models for predicting the lifetime of a customer relationship. As an example, Pareto/NBD (negative binomial distribution) model predicts the probability that customer relationship is alive (Pareto distribution) and the number of expected transaction in a given time period (Schmittlein et al. 1987; Fader & Hardie 2009). However, these models are not always easy to understand, and their implementation requires knowledge in statistics and special software:

“In a way, the salesperson wouldn’t have to use time for filtering or further understanding of the data. It should be as ready-chewed as possible. You could directly use it in your own work. That’s one goal.” (Analytics director)

The interventionist researcher who was in contact with the Analytics director suggested a specific “RFM analysis”. In contrast to sophisticated but potentially complex statistical tools, the RFM analysis is easy to understand and simple to implement. For example, the recency is an indicator of the existence of the customer relationship. The longer the time since the customer’s most recent purchase, the more likely the customer is lost. Especially, if customer has previously purchased on a regular basis. RFM analysis is widely used in the B2C marketing context (Verhoef et al. 2003). Importantly, in this research project, FleetCo would apply the RFM analysis in the context of the industrial services.

The RFM analysis was agreed upon. The data of the analysis covered spare parts sales from one Central-European country over six years (2011 – 2015). The number of customers was several hundreds and the number of orders was over 100 000 during the period. In addition to the RFM variables, the analysis was now supplemented with three industrial services specific variables: 1. The size of customer’s installed base 2. The number of different spare parts purchased by the customer during the period (part width) 3. The maximum amount of money spent with individual spare part during the period (part depth). These variables would explain customers’ behavior in the industrial service context.

The analysis divided each RFM variable into three categories. For example, customers who had placed orders in the last six months belonged to the R category 3. The R category was 2 if time since the most recent purchase was less than one year but over half a year. The rest of the customers belonged to the R category 1. In total, this division results into 27 categories. However, not every customer segment existed in the data. In addition, the researchers combined some categories, resulting in five appropriate customers segments (Table 3).

**Table 3.** Findings of FleetCo’s RFM analysis.

Category	Label	Explanation	Action
3x3x3 3x2x3 3x1x3	<b>Stars</b>	Best customers, they have high recency and volume.	Keep these customers. Analyze reasons for high volumes. Fleet size, spare width and depth indicate the opportunity to increase sales
3x3x2 3x3x1 3x2x2 3x2x1 3x1x2, 3x1x1, 2x3x2 2x3x1 2x2x2	<b>Betrayers</b>	Recency is high or medium, but the transaction frequency and monetary value are medium or low. Maybe betrayers buy some spare parts from competitors.	Difference in spare part width and depth compared to the Stars with similar fleet indicate the opportunity to increase sales.

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2x2x1 2x1x2 2x1x1			
2x3x3 2x2x3	<b>Frustrated</b>	These customers have not been active in the last half a year. Nevertheless, their volume is high. FleetCo may be at risk of losing these customers.	Contact
1x3x3 1x3x2 1x2x3 1x2x2	<b>Lost</b>	These customers have not been active for over a year, yet their volume is high or medium. Thus, the probability of loss is high.	Contact immediately
3x1x1 3x2x1	<b>New</b>	Recently active customers, but their volume is still low	Analyze customers' installed base (age, size, type, operating conditions) and offer spare parts following the analysis.
1x1x1	<b>Tail</b>	Small volume customers that have not been active for over a year.	Contact customers with high potential. Maybe a campaign?

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FleetCo was satisfied with the analysis and decided to take it to the test with some simplifications. A service development manager saw that the RFM analysis together with data from a CRM system would be a usable combination.

“We took the RFM analysis, filtered it into an easily readable form: we took some extra columns away from there. So, what we left was the customers who have historically ordered a wide range of spare and wear parts, and are quite significant players in terms of money – both [F and M] were '3' – but haven't ordered anything during the last half a year. [...] and also his [an area sales director's] comment was that 'of course this makes their life easier, because, at the moment, what they go through in sales meetings at an annual level, is which customers or accounts have been lost. [...] There's not this aspect about how widely they have ordered spare and wear parts earlier, on which rotation etc. [...] I see this information should be incorporated into the [CRM system].” (Service development manager)

Indeed, and linked to the CRM, whether a customer had been contacted was identified as a relevant driver for service sales potential:

“I see that visits and no-visits would make a magnificent addition to this. How can we activate these and provide the sales interface with really interesting data. Like 'allocate your limited resources to this or that account during the coming month at least, plus those key accounts of yours, on whose doors you're going to go knocking anyway'. No question about it, a very interesting addition.” (Service development manager)

”We got the customer contact activity data from the [CRM system]. [...] Calls to the customer, visits, etc. [...] Cross-referencing that data to the current version of the tool [...] That would give a direct hint about where attention has actually been paid to.” (Analytics director)

The role of the transaction frequency caused debate. In the B2C marketing, transaction frequency is important, since every visit to the store or to the online shop is a possibility to sell more products to the customer. However, in the B2B marketing, those customers who make several small transactions can be more costly to serve than customers that make only a few large orders per

year, because each additional order increases transactions costs, for example, offer and order processing and shipping costs.

“How many orders – we had some problems according to which the order frequencies could locate time-wise so differently. [...] For me, this is maybe a little difficult. The customer can belong to the [frequency, F] group '1', '2' or '3'. But at least I don't have a clear idea about what I should think about any of these – I don't know how it would affect any of our actions. [...] Particularly with regard to frequency. To me the figure there does not matter.” (Analytics director)

“I wonder what kind of categorization this would result if we ditch that frequency and would replace it with the potential, the growth potential as the third aspect. That way we could see whether it's a large customer now, has it been active, and if we have potential to grow that account.” (Analytics director)

Thus, in the industrial services context, the monetary value might be more important than transaction frequency. In addition, the long observation period of this study, six years, is problematic, since some customer relationships were born after the beginning of 2011. For these customers, the total number of transactions and volumes are not comparable as the duration of the relationship is less than six years. Hence, FleetCo wanted to change the method of calculating the F variable: instead of the total number of transactions, the tool shows the average number of transactions per month during the customer's activity period (the period starting from the first transaction and ending to the last transaction).

After simplifications and changes, the Sales manager tested the tool. The overall reaction was positive. He found the tool as easy to use and simple.

“Just a practical example: we were launching a new spare part product and were wondering how we could take it to the market. We used the information about the installed base: Where is the potential installed base for this new product? This was directly communicated to the market area and we even gave a proposition that 'these and these customers seem to have suitable pieces of machinery [for this service]'. In that way made life easy in the sales interface. So, we gave the explanation that 'this is this kind of a product, its technical specifications' and gave a list of the customers [about] 'these ones could be interested in purchasing this kind of service'. According to the feedback I have heard, this kind of an approach was really well accepted by the market. It really helps there.” (Analytics director)

However, FleetCo identified two main challenges related to the applicability of the tool. First, the implemented analysis was a one-time report. Regularly implemented or a real-time analysis requires changes in sales processes and information systems, including how sales efforts are prioritized.

“All these kind of analyses, they require the process: how this run then? How is it verified that it is used in the market area? [...] You can analyze so many things, you need to choose the objects of analysis and which processes are going to run. And how are these prioritized?” (Analytics director)

Second, how to motivate staff to use the tool regularly? Maybe more importantly, how to ensure that the results of the analysis will lead to actions and eventually increase sales and customer value?

“We are not trying to question salespeople's expertise but rather we wish to make it more efficient, and bring those new tools to the everyday work, to hopefully facilitate work even on the short term. [...] In one Central-European country, there were eight after-sales oriented salespeople in the beginning of last year. Now there

are six. And surely the amount will not increase at least in the coming year or two. So, it's acknowledged that tools are needed, there needs to be skills to use them, they need to be usable." (Service development manager)

"The higher-level analytics is starting to be quite in a good shape and it's ennobled already. But where I see the potential – and what perhaps is the thing for the future - is how we incorporate it [the analytics] in everyday work. Operative analytics. It's at a market-level and at a dealer-level." (Analytics director)

The Sales manager focused, in particular, on frustrated and lost customers. For each customer, he wrote down the reason for underachievement in sales. The analytics director divided reasons roughly into two parts: natural causes and excuses. Natural causes are causes that can immediately accept, such as customer no longer exists, the customer identification number has changed, or customer no longer uses the installed base. Excuses, in turn, are much more ambiguous, such as customer has no potential. Lack of potential is a good explanation if the customer's installed base is small. However, lack of potential is not a good explanation if the customer has a significant installed base. The true reason may be that the interaction with some customers is more difficult than with others. Contact with such customers is outside the sales staff's comfort zone and an easy explanation, such as lack of potential, provides an excuse. In all, a crucial problem was that those customers that FleetCo should have had information about, they did not, whereas they had more information about those customers to whom FleetCo already managed to do business with.

"There is this logical problem here. Those customers that we are in close contact with, to whom we sell a lot, and to whom we have recently sold [something]. More probably, we have a better picture about their installed base and how many hours per year the machines are running. Whereas on this list we have sorted out those customers that have not gained that much attention and here the information about the installed base is in a poorer state." (Analytics director)

In February 2017, research project members decided that now the ball is in the court of FleetCo. Interventionist research and neutral academic stance provide a premise to advance ideas within FleetCo. Next, FleetCo must internally ensure that the analysis results to actions. It is likely that the analysis itself will change too. However, all parties, management, analytics and sales, must be involved in the development. In the end, the RFM analysis is only technology, whereas CRM is a combination of technology, people and processes (Chen and Popovich, 2003).

At a level of analysis above a single segment, the RFM analysis had supported FleetCo's efforts to understand and develop their service business concerning separate segments. For example, whereas large and significant customers are interesting, small customers are easily disregarded. FleetCo's analysis also revealed the potential of summing up the small customers and examining their combined potential.

"It seems that we have these kind of customers [...] with 'not that high potential', and who are not... who at least don't seem to be the first ones in your mind. How many customers like these do we have? What is their combined potential? And can we do some more efficient marketing actions for these kinds of customers. Maybe that way get that business." (Analytics director)

Moreover, at an even more abstractive level, the analytics developed the way how FleetCo understood service business as a whole. In the end, the RFM analytics were only a tool for increased MA support for the sales interface.

"You have to be careful not to too much focus on the analysis itself. Like, 'now we have this RFM'. Maybe fundamentally, this is just about sales planning and management." (Analytics director)

Altogether, FleetCo's case study shows that the RFM analysis could support the company at a segment level wider levels about how installed base information is understood as a part of service sales planning and management. Installed base information pinpointed useful segments within FleetCo's customers and provided easy-to-use decision-making tools for the sales interface, i.e. about how the salespeople could more efficiently focus their work. For the back office, installed base information combined with CRM data, could enable pinpointing customers who had potential but had possibly been contacted too seldom.

#### *RFM analysis at ProcessCo*

The study at ProcessCo highlighted the need to further examine the customer base of the company. Actually, at the end of the meeting reviewing the results of the study, a spare part director indicated that:

"We need to go deeper in the customers' sales history" (Spare part director)

Therefore, it was suggested by the company people that a tool indicating customer-specific sales would be useful. Especially, they were willing to find out the top customers, as well as the potentially lost customers. In addition, they think that it would be necessary to see whether the customer purchases small orders on a regular basis or large orders rarely. ProcessCo also hoped that the tool could enable the user to drill into customer level data. The company people thought that this type of tool might facilitate both everyday work and long-term management of spare part sales in several ways. Based on above-mentioned requests, it was natural to adapt the RFM tool initially developed for FleetCo to examine the customer base of ProcessCo as well. Hence, a valuable possibility to validate FleetCo's findings now emerged.

At ProcessCo, the analysis focused on spare parts sales from one country/sales company over six years period (2010-10/2016, Table 2). In all, the data covered slightly over hundred of customers and the number of orders was over two thousand. In addition to the RFM variables, the analysis included information about the pieces of machinery at a customer's site. However, the application of the tool was a little simpler (than in FleetCo's case) with regard to sold spare parts and installed base data. ProcessCo's equipment are highly customized according to customer demands and their item management is quite complex. Thus, it was not possible to take into account the data concerning the sold spare part items. While there was not comprehensive installed base data available, the tool relied on the data gathered from ProcessCo's CRM. However, the problem is that when relying on CRM data it is possible to get only the total amount of equipment per customer but it is not known how the equipment are used at customer site. It could be, for example, that customer has three different equipment of which one is in regular use, the other one is used as a spare device and the oldest one is used only as a test equipment. Hence, to better indicate the business potential, the installed base data should be more informative.

The meeting reviewing company people's perceptions of the RFM tool revealed many potential ways to utilize it and pinpointed potential development targets. According to the spare part director:

"The first impression is that this is useful to us, it is not too academic." (Spare part director)

Especially for the spare part experts responsible for daily sales activities, the possibility to drill into customer-level data was seen very important. For example, sales people could use the tool for customer prioritizing when preparing tenders. If the salespeople are in a hurry, they will likely first respond to top customers. Based on the customer specific data it is possible to recognize the trends in purchase history and analyze the causes and effects of changes. As in the FleetCo case, the role of transaction frequency caused debate among the company people. Indeed, the customers' pre-planned shutdown projects play a major role in ProcessCo's spare part business

and thus the orders are often placed cyclically. The nature of business transactions should therefore be taken into account when analyzing the customer specific data. A further validation of the RFM analysis as a possible tool for ProcessCo was given by the spare part director who indicated that:

”It could be a quarterly tool and enables to look forward...in that sense it is a better tool as it is possible to drill into customer level” (Spare part director)

In the analysis at ProcessCo, each RFM variable was divided into three categories and the company people suggested that the customer segments defined in FleetCo case (Table 3) are applicable in ProcessCo case as well. In practice, segmentation of customers into different categories may facilitate decision making at different levels and in different roles. As the following quote from ProcessCo indicates, the tool can be very useful for individual salespeople.

”From this, you have to look at the direction on which to target the navigator... Where you should visit, as you are already a gifted speaker” (Spare part expert, team member to another team member)

In turn, especially for managers responsible for global sales, the tool could provide supportive information for long-term planning. In this regard, deriving insights from the analysis of customer segments may help in orientating the local sales forces to the right customers.

It was justified to test the idea and applicability of the RFM tool with a certain data set and thus the first version covered sales data of only one country/sales company. However, the next version of the tool will cover data from all country/sales companies and regarding that, the spare part director highlighted that:

”It is important to see the global picture” (Spare part director)

In addition, the main development needs identified concerned the installed base information. Actually, the input data of the tool contains several data fields from which it is possible to derive installed base information. However, none of them gives a perfect picture and thus the company people will try to figure the best possible option that can be adopted into the tool. As the equipment and spare part sales are normally examined separately, this tool can be seen as promoting the equipment fleet based management of spare part sales.

In all, the RFM analysis seemed to be an applicable tool for ProcessCo as well. This was because of the simplicity, usability and visual appearance of the RFM tool. More importantly, its potential as a sales support tool was recognized and ProcessCo will take it into use in the near future. Importantly, and perhaps more visibly than at FleetCo, ProcessCo’s study underlined the RFM tool possibly as a decision-making aid at a salesperson’s level. The tool could, for example, actually point out the next location the salesperson should possibly focus his or her efforts on. Impressions of similar use could be seen at FleetCo as well, but they at this point involved the back-office manager who provided the salesperson with a set of interesting or abnormal customers.

## **Discussion and conclusions**

### *Overview of the contribution of the paper*

Our interventionist case studies from FleetCo and ProcessCo strengthened the understanding that there is indeed potential in using installed base information for service business development. In particular, this paper adds to the studies by Wagner and Lindemann (2008), Holmström et al. (2010), Dekker et al. (2013), and Rabetino et al. (In press), by showing the possible ways of using installed base information in service management. This study adds to the literature on servitization by showing beneficial types of information about customers that industrial companies need to focus on in order to create value from acquiring larger shares of their potential service business



market (Oliva & Kallenberg 2003). This paper shows that fleet characteristics combined with the RFM analysis can support service sales both in the sales frontline and in the back office. Especially, we contribute to the literatures on servitization and service business development by using the RFM analysis that has earlier been adopted in the B2C context: we show that the RFM analysis can be applied in the industrial service (B2B) context but needs to be supplemented with variables describing the fleet size, service type width and service type depth.

This paper also adds to the literature on profitability management in services (Araujo & Spring 2006; Baines et al. 2009; Laine et al. 2012a; 2012b; Korhonen et al. 2016; Lindholm et al. 2017). Particularly we add to these studies by showing how companies could structure and utilize their installed base data for service business development. In our paper, FleetCo's case study laid the foundation for using the RFM analysis in the industrial service (B2B) context and ProcessCo's case study offered some validation for the initial findings, by showing that the RFM tool developed was seen as a potentially useful aid in managerial work in service business development (cf. Hall 2010). In all, we show how the practices of accounting can support service business development.

Next, we are going to go in more detail in these contributions. We create three propositions for future research to address and revise the tentative framework of the paper.

#### *Our contribution to the literature on service business management*

This paper shows that OEMs could use the RFM analysis for customer segmentation in the industrial services context. The analysis is useful when OEMs want to identify, for example, lost customers, customers that are in danger of losing (frustrated), star customers, and potential customers (betrayers).

The research revealed differences between the industrial service context and the consumer business context in using the RFM analysis. In particular, the importance of variables, R, F and M is not the same in the industrial services context than in the B2C marketing. Especially, the role of transaction frequency is controversial: From OEM's point of view, a customer who makes fewer large orders is cheaper to serve than a customer who makes a number of small orders. Thus, in the industrial services, customer's monetary value might be more important indicator than transaction frequency. Indeed, our empirical findings show that the frequency variable in industrial service purchases might not be as relevant as in the consumer business. However, our data shows that the frequency variable is not irrelevant – rather, we expect its meaning to depend on the context. For example, an industrial service provider would hardly be content if a customer places an order every ten years. Neither would the service provider possibly wish that the customer orders would take place on a daily basis. There is some middle way, depending on the context: this middle way allows both tight customer relationship and enough room for coordinating the service operations. This finding leads to our first proposition for future research to address:

*Proposition 1: The frequency variable in RFM analysis is a less direct driver of service business potential in the industrial service context than in the consumer business context.*

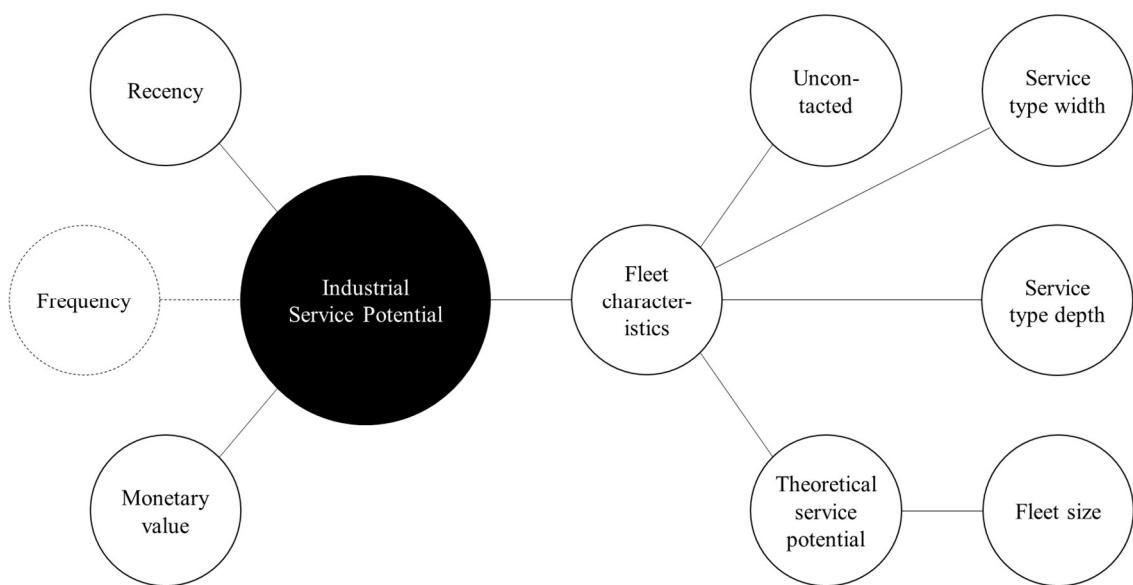
In addition, the research showed that the number of customer segments might be lower in the B2B than in the B2C context. This is particularly true in the industrial services context where companies have typically hundreds or thousands of customers whereas in the B2C marketing companies can have millions of customers. As an example, this study identified only six meaningful customer segments.

Moreover, this study demonstrates how OEMs can extend the traditional RFM analysis; this is an important contribution to studies that notice the relevance of installed base data for service

business development (Wagner & Lindemann 2008; Holmström et al. 2010; Dekker et al. 2013; Rabetino et al. In press). The extended analysis includes four additional variables: 1. The size of a customer's installed base 2. The number of different services (such as spare parts) purchased by a customer during a period (service type width) 3. The maximum amount of money spent with individual types of service (such as spare parts) during a period (service type depth) 4. Altogether fleet service business potential. OEMs can use these additional variables for evaluating the overall customer potential and finding useful sales points. These supplementing variables lead to our second proposition:

*Proposition 2: The size of the installed base, service type width, service type depth, and whether a customer has not been contacted are drivers of service business potential in the industrial service context.*

Finally, our empirical findings enable us to revise the tentative framework of the paper. Figure 2 shows the revised framework.



**Figure 2.** Exploratory findings on the meaning of different variables in the fleet service context – a revised framework.

This revised framework holds both academic and practitioner implications. First, academic researchers can supplement RFM analysis in different service management contexts by the novelties of our revised framework. Second, practitioners can use the revised framework in governing their service development.

#### *Our contribution to management accounting and control supporting servitization*

The wider implications of our findings relate to the servitization literature that is in search for tools and techniques to enable and support the service transformation (Baines et al. 2009). In essence, the application of RFM, modified to the fleet service context represents an example of such tool. At the same time, and as a wider implication to the management accounting and governance literature (Araujo & Spring 2006; Baines et al. 2009; Laine et al. 2012a; 2012b; Korhonen et al. 2016; Lindholm et al. 2017), the utilization of such a tool requires rethinking of the units of analyses traditionally used in the decision-making. This rethinking also involves various relevant parties in the decision-making and implementation processes, to realize the potential impacts of the enhanced awareness about customers.

In all, our empirical findings show that service management can be supported at three different levels of management accounting and control. First, the refined RFM analysis can be used at the

level of a single customer case (like in deciding to which customer the salesperson is going to call next). Second, the refined RFM analysis can help in identifying certain specific customer segments and therefore support focused actions and campaigns, for example. Third, the refined RFM analysis can support the development of the whole service system and organization and give inspiration about how a customer segment relates to the wider picture of service management within a company. This level of analysis connects to wider organization and responsibility structures in service business development. These findings lead to our third and final proposition:

*Proposition 3: The RFM analysis supplements profitability consciousness when used together with information about the profitability of different products and services.*

### *Conclusions and future research agenda*

This paper has shown the new directions for analyzing installed base data and using it for service business development. In all, our interventionist case studies show that certain aspects of management accounting and control for service business development are typically situated outside normal yearly and monthly reporting.

Importantly, we have provided the academia with a refined RFM framework, specifically to be used in the industrial service context. Further, we have made three propositions for future researchers to address. Finally, service type width and depth are concepts that are potentially transferable across different context: their wider plausibility is an important agenda for future researchers to address.

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ISBN 978-952-15-4249-7  
ISSN 1459-2045