Tampere University

KHADIJEH MOMENI

Service Integration in the Downstream Value Chain of Project-based Firms

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ACADEMIC DISSERTATION
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Responsible supervisor and Custos	Professor Miia Martinsuo Tampere University Finland	
Pre-examiners	Senior Lecturer Aku Valtakoski Linköping University Sweden	Associate Professor Anne Live Vaagaasar BI Norwegian Business School Norway
Opponent	Professor Mats Engwall KTH Royal Institute of Technology Sweden	

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“What you seek is seeking you”

- Rumi

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Seven years ago, I arrived in Finland to pursue my MSc in Business and Technology without knowing that I would call this beautiful country my second home in the next few years. Before I started my master's thesis, I had the intention of continuing further as a doctoral student, but I had some concerns about working as a researcher at the university. However, during writing my Master thesis at the university under the supervision of Professor Miia Martinsuo, I realized how much I enjoyed working as a researcher. The freedom that I was afforded, my talented and inspiring colleagues, the joy of teaching and the dynamic research process were among the key factors that ultimately pushed me to become a doctoral student. My doctoral studies have been a great journey filled with learning, growth and development both personally and professionally. Finally, here I am, writing the last sentences of my thesis. Many people and organisations have contributed to this process in various ways, and I would like to mention some of them specifically.

I would first like to thank my supervisor, Professor Miia Martinsuo, for giving me the opportunity to try my hand at research work and supporting me over the years. I am grateful for your patient guidance, enthusiastic encouragement and constructive feedback throughout the research and writing processes. Your deep insights helped me at various stages of my research. I also remain indebted for the confidence and freedom that you gave me to undertake the research work. Thank you for all of the training that you provided along the way, the discussions, idea generation, co-authoring and, above all, for being there to listen when I needed an ear.

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assistance with the data collection. The people involved not only provided empirical material but also were great sources of inspiration and ideas.

It is an honour to have Professor Mats Engwall from KTH Royal Institute of Technology as the opponent for my thesis defence. Thank you for your time and commitment in reading the manuscript and participating in the thesis defence. I am especially indebted to those individuals who have read and commented upon the material along the way. Specifically, I would like to express my appreciation to Dr Anne Live Vaagaasar and Dr Aku Valtakoski, the pre-examiners of the thesis, for their invaluable comments and suggestions for improvements during the final stage of the thesis work. I would also like to thank Professor Lars Lindkvist for hosting me at Linköping University and providing comments and advice on ways that I could improve my research. Further, I am grateful to the journal editors and anonymous reviewers who provided important feedback and suggestions on how I could improve my articles during the research process.

Doctoral students often refer to experiencing loneliness during their studies, but this is something that I never experienced as part of the CROPS research group. To all of my current and past colleagues – especially Eija, Lauri, Matias, Pooja, Rami, Rehab, Toni and Tuomas – thank you for providing an inspiring work environment, constructive advice and general help and friendship. To the S4Fleet doctoral students group – Eija, Lauri and Markus – thank you for your company and support during this process. In addition, I cannot think of the past five years without mentioning Santeri, Teemu and Tommi. Thank you for modelling great teaching and for advancing my thinking about teamwork and learning. I would also like to extend my appreciation to all of my colleagues in the Department of Industrial Engineering and Management and everyone who contributed directly or indirectly to the thesis.

Many thanks also to all of the dear friends who reminded me of the world outside the university. I am grateful for your thoughts, well wishes, phone calls, visits, delicious meals, movie nights, game nights and presence whenever I needed a friend. You offered tremendous support by providing happy distractions from my research whenever my mind needed a rest.

The completion of my thesis would not have been possible without the support and nurturing of my family. I am especially grateful to my parents, who believed in me and wanted the best for me. Mom and Dad, thank you for encouraging me in all of my pursuits and inspiring me to follow my dreams. To my sister, who has always loved me unconditionally, many thanks for supporting me spiritually during the writing of this thesis and in general throughout my life.

Finally, I wish to thank Hamed. You have been a constant source of support and encouragement throughout the challenges of my doctoral studies and life. I am truly thankful for everything and especially for all of the little things you do. Thank you for staying awake while I worked late nights. Thank you for those weekends when you sat on the coach and watched your favourite TV series almost on mute, so that my work would go a little quicker. Thank you for being the best chef in town. You were patient with me when I was frustrated; you celebrated with me when even the littlest things went right; and you supported me in overcoming difficulties without complaining. Thank you for all your love, understanding and support.

ABSTRACT

Many project-based firms have become solution providers that offer a combination of products and services as life-cycle solutions, i.e., solutions that offer value to customers over time. Firms involved in solution business need to acknowledge customers' needs and integrate different components to deliver higher value to customers. However, integrating services into solution offerings is not straightforward and imposes different challenges and changes to project-based firms. Such integration is not limited to system integration that involves suppliers in the upstream value chain during the project execution phase. The downstream value chain, where project-based firms face customers also features an integration challenge. Integrating services successfully in the solution offering requires that project-based firms consider the downstream integration needs of distributors as well as internal business units that are involved in solution sales and delivery.

This research aims to increase understanding of the operational implications of integrating services with solution offerings and the related internal and external integration practices. Previous research has considered systems integration at the strategic, organisational and project levels, and particularly from the perspective of supply and the upstream value chain. While it acknowledges the need for changes in the organisation of project-based firms' transition towards solution business, practices in the downstream value chain are not sufficiently known as of yet. The downstream value chain is where customer value is defined with the customers and delivered to them. The internal and external actors in the downstream value chain are the most neglected actors of project-based firms. Project-based firms need strong practices for integrating different actors and services to solution offerings, ultimately to succeed in delivering lifecycle solutions.

Four qualitative case studies were conducted herein with respect to project-based firms in the engineering and technology industries focusing on different aspects of integrating services to solution offerings. The findings show that integrating services with solution offerings challenge solution sales and delivery and creates several integration requirement in sales and service work. Project-based firm needs to organise the sales and service work to respond to challenges resulting from the

increased service orientation. The identification of challenges at the practice level enhances the current understanding of the experiences of individuals in internal business units in integrating services. Various integration practices were mapped, in use among different actors in the downstream value chain, including the interface of project operations and services, sales and services, and project-based firm and distributors. As actors in the downstream value chain have a stable position within the permanent organisations and service delivery lasts quite a long time after project delivery, integration at the business level is critical for improving interpersonal and organisational relationships and facilitating integration practices at the project level.

This research contributes to the solution business and supply chain integration literatures. It illuminates what it takes to integrate non-core actors in the downstream value chain of project-based firms at the practice level. Moreover, this study suggests specifying the challenges that emerged through integration of offerings and proposes suitable integration practices to overcome various integration challenges. As well, the research contributes to supply chain integration knowledge by describing the importance of integrating with distributors as intermediaries between project-based firms and customers. Overall, this research made six propositions regarding selection of organisational integration practices based on type of challenges to overcome, solution life cycle, type of interfaces, the experience level of actors, and uncertainty in the environment. For managers, this research provides insights into the challenges at the sales-service, project operation-service, and project-based firm-distributor interfaces. Different organisational integration practices are posited to facilitate integration across internal and external actors, thereby integrating services with solution offerings successfully.

CONTENTS

ORIGINAL PUBLICATIONS

Publication I Momeni, K. and Martinsuo, M. (2018). Remote monitoring in industrial services: Need-to-have instead of nice-to-have. Journal of Business & Industrial Marketing, 33(6), 792-803.

Publication II Momeni, K. and Martinsuo, M. (2018). Allocating human resources to projects and services in dynamic project environments. International Journal of Managing Projects in Business, 11(2), 486-506.

Publication III Momeni, K. and Martinsuo, M. (2019). Going downstream in a project-based firm: Integration of distributors in the delivery of complex systems. International Journal of Project Management, 37(1), 27-42.

Publication IV Momeni, K. and Martinsuo, M. (accepted). Integrating services into solution offerings in the sales work of project-based firms. Accepted for publication in International Journal of Project Management.

AUTHOR'S CONTRIBUTIONS TO THE PUBLICATIONS

In the following, the researcher's contributions to the articles are described.

For Article I, I carried out a major part of the literature review, collected and analysed data, and wrote the full draft of the paper. The idea of the paper and positioning were developed with the co-author. The discussion and conclusion sections were developed in collaboration with the co-author. Feedback from the anonymous reviewers of *Journal of Business & Industrial Marketing* were considered jointly with the co-author and taken into account when drafting the final version of the paper.

For Article II, I carried out the literature review, collected and analysed data, and wrote the full draft of the paper. I developed the original idea in collaboration with the co-author. Further, I developed the content for the discussion and conclusions, which were further crafted in collaboration with the co-author. I presented an early version of the paper at EGOS conference (European Group for Organisational

Studies Colloquium, 7-9 July, 2016, Naples, Italy). After the conference, the paper was fully revised under the guidance of the co-author. Feedback from the anonymous reviewers of *International Journal of Managing Projects in Business* were considered jointly with the co-author and taken into account when drafting the final version of the paper.

For Article III, I carried out the literature review, collected and analysed data, and wrote the full draft of the paper. I developed the original idea and content for the discussion and conclusions. The co-author reviewed the paper and commented on all parts. I presented an early version of the paper at IRNOP conference (International Research Network on Organising by Projects Conference, 11-14 June, 2017, Boston, USA).The paper was further developed in collaboration with the co-author. Feedback from the anonymous reviewers of *International Journal of Project Management* were considered jointly with the co-author, and I wrote the revised versions of the paper with the aid of the co-author's guidance, and this led to completing the final version of the paper.

For Article IV, I carried out the literature review, collected and analysed data, and wrote the full draft of the paper. The original paper idea and position of the paper were developed in collaboration with the co-author. I crafted the content for the discussion and conclusions. The co-author was especially involved in developing the propositions, reviewed the paper, and commented on all parts. I presented an early version of the paper at EURAM conference (European Academy of Management conference, 20-23 June, 2018, Reykjavik, Iceland). The paper was further drafted in collaboration with the co-author. Feedback from the anonymous reviewers of *International Journal of Project Management* were considered jointly with the co-author, and I wrote the revised version of the paper with the co-author's guidance, and this led to completing the final version of the paper. The paper is now accepted for publication.

1 INTRODUCTION

1.1 Background and motivation

Technology-based firms in various industries, such as aerospace, shipyards, engineering, etc., typically organise their business activities through projects (Ahola et al., 2017). These firms become project-based firms and deliver highly differentiated and customised offerings to their customers (Hobday, 2000; Artto et al., 2015). In project-based firms like General Electric and Siemens, there are specific organisations, units, or divisions within the firm that are responsible for the project business, and there are functional units that support said project business (Brady and Davies, 2004). The delivery of complex projects by project-based firms often demands multiple networks, alliances, and partnerships (Whitley, 2006) along with the integration of diverse resources and expertise (Keegan and Turner, 2002; Lindkvist, 2004). The integration of actors becomes more important when project-based firms extend their offerings from product-centric project deliveries to solution deliveries (Brady et al., 2005; Jalkala et al., 2010). This study calls this bundle of product and service components "life-cycle solutions". The life-cycle solution delivery projects are different from product-centric projects because combining products and systems with services extends the ordinary project lifecycle to the pre-project phase and post-project operation phase (Brady et al., 2005). Solution-centric project-based firms, in practice, face challenges when integrating various types of offering components and actors to provide value-adding solutions to their customers.

The present research combines two distinct integration challenges concerning life-cycle solutions under the umbrella term of "service integration", referring to the process of the integration of offering (i.e., combining service and project components) and the organisational integration of business units, partners, processes, people, and technology to enable integrating service business in the existing value chain of the firm. Starting from the illustration of the service delivery scope during the solution lifecycle by Artto et al. (2008), Figure 1 illustrates the concept of service integration in this study.

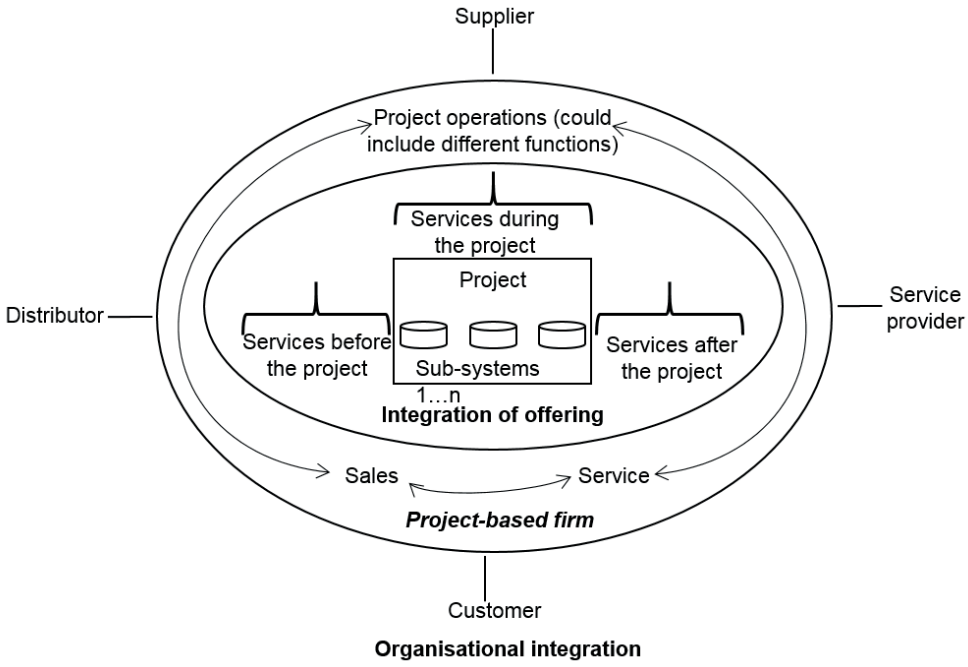


Figure 1. The concept of service integration in this study

First, project-based firms may struggle to integrate project and service components due to the differences between the business logic of project and service business (Artto et al., 2015). The present study adopts Vargo et al.'s (2008) definition and defines service as the application of competences by one entity for the benefit of another. The service may include both intangible and tangible elements that facilitate value creation for customers (Kujala et al., 2013). Conventional project deliverables and services have different characteristics that stem from the differences between products and services (Kujala et al., 2013). The latter differ from products in terms of intangibility, simultaneity, perishability, heterogeneity, and customer inputs (Zeithaml and Bitner, 2000; Sampson and Froehle, 2006). Due to these differences, product business and service business are dissimilar in terms of the assessment of effectiveness and efficiency, production strategies, and production processes (Bowen and Ford, 2002). Furthermore, projects as a specific organisational form have a different business logic than service business (Alderman et al., 2005). While project business concentrates on milestones and delivering project results on time as well as within budget and scope, service business operates through an ongoing process of responding to changing customer needs (Ojansivu and Alajoutsijärvi, 2015). Unlike projects that belong to a temporary organisation (Lundin and

Söderholm, 1995), services are provided by the permanent organisation and can last for a long time after project delivery (Ojansivu and Alajoutsijärvi, 2015).

Earlier research has mainly provided a macro-level analysis and concentrated on the impacts and enablers of integrating projects and services at the strategic level (e.g., Artto et al., 2008; Wikström et al., 2009), leaving a gap in the micro-level analysis of the organisation related to exploring **the implication of adding services into solution offerings at the practice level**, i.e., the actions of business units involved in the solution delivery projects. Complementing project deliveries with services has been receiving increasing attention from project-based firms and project-oriented research and has increased the amount of study focused on incorporating projects and services (Burström et al., 2013). Researchers have studied project-related services from the perspective of their business potential and ability to create deeper and longer customer relationships. Previous studies have already mapped the diverse impacts that services may have on the performance of project-based firms (Artto et al., 2008), the alternative business logics of project-related services (Wikström et al., 2009), and solution-specific business models of project-based firms (Kujala et al., 2010; Kujala et al., 2011). The literature has also demonstrated how services are used to support the business of project-based firms (Kujala et al., 2013) and to extend project life cycles beyond the delivery phase (Brady et al., 2005).

Second, project-based firms face unique organisational integration challenges through the involvement of internal and external actors during solution delivery. Internal actors refer to organisational units inside the firm, and external actors refer to independent organisations outside the firm's boundaries that collaborate with the project-based firm in solution delivery projects. The present study follows the supply chain management literature (Flynn et al., 2010; Schoenherr and Swink, 2012) and defines integration as the collaborative management of intra-organisational interfaces (i.e., internal integration) and inter-organisational interfaces (i.e., external integration). As focal firms, project-based firms need to manage upstream and downstream value chains to acquire, share, and consolidate knowledge within the organisation itself and with external actors (Swink et al., 2007). The value chain consists of all value-added activities that contribute to the final value of a set of related products and services (Sturgeon, 2001; Stonehouse and Snowdon, 2007), and it is usually divided in two segments, including upstream and downstream activities.

These segments are distinguished through their unique business problems, operation environments, organisations, and required capabilities (Davies, 2004). In the upstream value chain, the project-based firm integrates with suppliers to design and execute projects. In the downstream value chain, the firm integrates with customers (and possibly other intermediaries) to sell and deliver the project as well as to maintain and support the operation of the project deliverables (Jalkala et al., 2010).

The prominent research stream on solution-centric project-based firms has explored system integration capability (e.g., Davies and Brady, 2000; Davies et al., 2006) through integration practices within core project teams (e.g., Adenfelt, 2010) and with upstream actors, such as suppliers and contractors (e.g., Aagaard et al., 2015; Ahola et al., 2017). However, the research on **cross-functional integration practices for adding services to solution offerings** is quite limited (e.g., Artto et al., 2015; Ståhle et al., 2019). The literature has also acknowledged the importance of customer integration and relationships for solution business (Brady et al., 2005) to address the discontinuity problem of project-based firms (Hadjikhani, 1997) and has investigated the integration between project-based firms and customers, especially during the design phase (Dvir, 2005; Kujala and Ahola, 2005). However, the studies on project-customer relationships mainly deal with the direct relationship between project-based firms and customers (e.g., Peled and Dvir, 2012; Hsu et al., 2012) while **the role of intermediaries in the downstream value chain** has not been studied in much depth.

In summary, the solution lifecycle is not limited to customising and bundling products but consists of different phases (Tuli et al., 2007). The present study adopts Storbacka's (2011) solution business model as a starting point. The order of phases in the framework was modified to illustrate the reality of solution delivery projects and operations, and the service phase was emphasised by assigning a separate phase in the solution lifecycle (Figure 1). Linking the solution lifecycle with the value chain of project-based firms reveals two sets of solution lifecycle phases, namely the "supplier-facing" and "customer-facing" phases (in line with Schoenherr and Swink, 2012). Figure 2 illustrates the solution lifecycle and the position of phases in the value chain, highlighting the position of this study. This research concerns service integration practices, particularly during the customer-facing phases in the downstream value chain of life-cycle solutions.

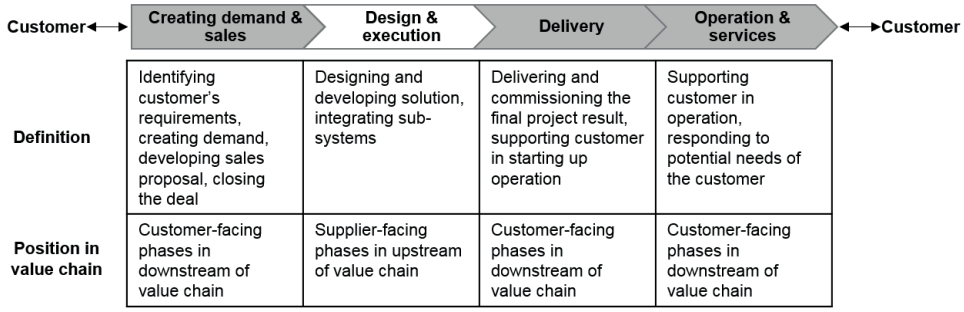


Figure 2. Customer-facing phases of the downstream value chain of project-based firms

1.2 Research objectives and research questions

This study explores the operational implications of integrating services with solution offerings and the related internal and external organisational integration practices. It aims to create new knowledge on integrating complementary resources to enhance solution delivery during the extended project life cycle (from marketing and sales to after-sales services). Project-based firms as a specific type of organisation conduct business within a network of actors (Artto and Wikström, 2005). Firms use various mechanisms and approaches to integrate the capabilities of internal and external actors and do so effectively. The technical integration of projects and services and providing life-cycle solutions to fulfil technical requirements of the final outcome (Kirsilä et al., 2007) make the issue of integration more vital for project-based firms (Hobday et al., 2005). Despite the strategic importance of integrating projects and services that has been underscored in the literature, it remains unclear what the integration of services into solution offerings implies in terms of the work of project-based firms. This study aims to fill the research gap by providing a new conceptual understanding and empirical insight into service integration. Therefore, the main research objective of this dissertation is:

To characterise the implications of service integration in the downstream value chain of project-based firms and to describe organisational integration among internal and external actors in practice.

To achieve this objective, two main research questions were formulated to explore service integration from the perspective of the project-based firm. The first research question explores the integration of service and project components into solution offerings. The second research question inquires into the integration of

actors in solution delivery. The research topic, service integration, will extend earlier theories on life-cycle solutions. From a managerial perspective, the present research intends to help project-based firms struggling with solution delivery to broaden their views on how service integration occurs at the practice level. Integrating their core project teams with other critical actors through this enhances the project-based firms' possibilities for successful solution deliveries.

RQ1: How do project-based firms integrate services with projects in the downstream value chain?

The first research question seeks a broad understanding about the integration of projects and services at the practice level. Given the aim to enhance understanding regarding the downstream value chain, challenges and changes associated with integrating services with the solution offerings in the work of customer-facing phases, i.e., solution sales and delivery, are included. Article I focuses on advanced information and communication technology (ICT) systems and explores how firms can benefit from adding new services to their offerings and how ICT systems can enhance customer relationships. Article II was designed to focus on solution delivery. Specifically, the article investigates the challenges of allocating service resources to deliver project-related services in a dynamic project environment and practices to manage uncertainty in resource allocation. Article IV concentrates on solution sales – its purpose is to identify challenges of service integration for sales units.

RQ2: How do project-based firms integrate internal and external actors in the downstream value chain?

The second research question investigates intra- and inter-organisational integration in the downstream value chain. Project-based firms usually have separate organisational units for project and service businesses (Artto et al., 2015). However, managing customer relationships requires cooperation between organisational units (Skaates et al., 2002). While collaboration between units has been stressed in previous literature, integration practices have received little attention (Artto et al., 2015). Article II focuses on solution delivery and explores integration practices between project operations and service operations. Article IV investigates integration practices in adding services to solution offerings across the sales-services interface. Project-based firms also require collaboration with different actors in value chains to develop, sell, and deliver life-cycle solutions (Hobday et al., 2005). The enhancement of relationships and integration with suppliers has received considerable interest in previous research (Eriksson, 2010; Martinsuo and Ahola, 2010). The role of customers along with the impacts of and means of customer integration have also been assessed in multiple studies (Peled and Dvir, 2012; Voss,

2012). However, there is lack of enquiry into integration with distributors as potential actors in the downstream value chain. Article III focuses on the role of distributors in project-based firms and distributor integration mechanisms.

1.3 Research process

This research was conducted within the research programme: DIMECC's Service Solutions for Fleet Management (S4Fleet), funded by the Finnish Technology and Innovation Agency, Tekes, companies, and research institutes, and coordinated by DIMECC – Consortium for Digital, Internet, Materials & Engineering Co-Creation. The S4Fleet programme included project-based firms offering a variety of products, complex systems, and services, their industrial offerings usually being tailored specifically for each customer, and the service business has become an important feature of their portfolios. Figure 3 illustrates the relationship between the case studies, the original articles, and the research questions.

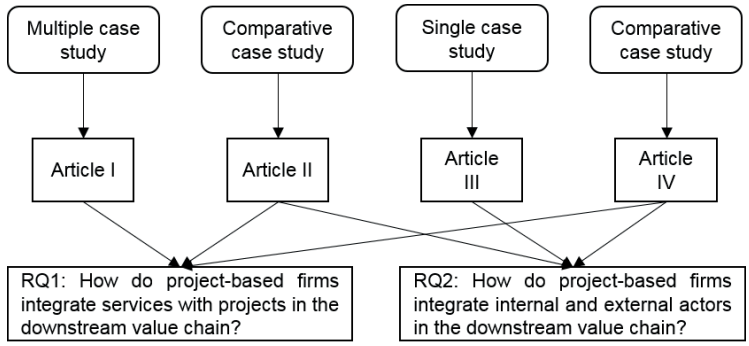


Figure 3. Composition of the original articles

The first step of the research process (2015-2016) was preliminary research of six case companies to investigate the current state of firms and changes in their business environment with a specific focus on moving towards service business and using advanced technology. A review of the literature on servitization and adoption of advanced ICT systems was conducted. The data was collected through semi-structured interviews with business development managers and service managers. As a result, Article I was written and published in the Journal of Business & Industrial Marketing. The interviews revealed the effects of ICT systems in solution sales and delivery. Meanwhile, the findings showed the important role of ICT systems as one

component of life-cycle solutions, demonstrating the use of advanced systems to enhance customer relationships and integration. The results functioned as a starting point for the dissertation.

In the second step (2016-2017), the researcher evaluated intra-organisational relationships for delivering solutions by exploring the challenges emanating from cooperation between service organisations and project organisations. The need to study intra-organisational relationships between project team and service units emerged from initial interviews with service managers. Service managers explained how allocating the service staff to both service and project tasks created resource allocation issues in their organisations. A review of the literature on resource allocation issues and approaches in project-based firms as well as managing resource allocation issues in a dynamic environment was carried out. Empirical data was collected through semi-structured interviews with service managers, service staff, and other key actors of service business. As a result, Article II was written and published in International Journal of Managing Projects in Business.

In the third step (2017), the researcher concentrated on inter-organisational relationships in the downstream of value chain by studying integration of distributors in project-based firms. Distributors have an increased role in sales channels, especially in manufacturing firms (Ghosh et al., 2004). The literature review on the integration of external actors in project-based firms uncovered that previous studies centred on the upstream value chain and a project-based firm's relationship with suppliers as well as on the downstream value chain and a project-based firm's relationship with customers. To assist elucidating the role of distributors in project-based firms, the previous literature regarding distributor capabilities and issues in the downstream value chain of project-based firms were studied. The data was collected through semi-structured interviews with distributor directors and other supporting and informative actors within distribution management. As a result, Article III was written and published in International Journal of Project Management.

In the fourth step (2018), the researcher returned to intra-organisational relationships by focusing on solution sales work. The need to study the relationship between project sales and service sales organisations originated from initial interviews with business development managers and a review of the previous literature. Business development managers described how the sales work can hinder offering solutions to customers. A review of the extant literature on solution selling and delivery uncovered that firms expanding their business towards life-cycle solutions must develop specific capabilities and business models for selling solutions (Storbacka, 2011;Töytäri and Rajala, 2015; Kujala et al., 2010). Therefore, project-

based firms have to understand the new tasks that emerge from adding services to solution offerings and integration practices between project sales and service sales. To assist in the comprehension of integration requirements in solution sales, the literature on integration approaches to integrate project and service works in project-based firms was assessed. Empirical data was gathered through semi-structured interviews with sales and service managers. As such, Article IV was written and accepted to be published in International Journal of Project Management.

The current dissertation is organised as follows. First, the Introduction chapter presents the background and motivation, research objectives and questions, research processes, and an outline of the original articles. Second, the Literature Review chapter features the theoretical background on life-cycle solutions of project-based firms, integration of offerings, and organisational integration. The thesis applies a supply chain-integration perspective to evaluate integration practices in the downstream value chain. This chapter provides a synthesis of the literature review and research gaps. The Methodology chapter outlines the research strategy, research context, research methodologies underlying each article, and data analysis along with validity. The Findings chapter summarises the main results and contributions of the original articles. Finally, the Conclusion chapter presents the theoretical contributions, managerial implications, limitations of the study, and suggestions for further research.

1.4 Outline of the original articles

Article I addresses the problem of generating business value through advanced information technology (IT) technologies. Based on the identified issues related to the relationship-based customer information channels, they highlight the need for advanced technologies, such as remote monitoring systems (RMS) in enabling manufacturing firms to complement their knowledge surrounding their customers and improving the efficiency of services through enhanced knowledge access, removal of physical distances, and better validity and quality of data. The empirical findings show that successful adoption of RMS in manufacturing firms' service business features business-related factors that can enhance or restrict the use of technologies in companies. The paper highlights possible broader applications of RMS in a manufacturing firm's business, in customer relationship management, marketing, product and service development, and the customisation process. The study argues that manufacturers cannot succeed in enhancing the adoption of RMS

by concentrating on technical enablers exclusively; they should utilise the collected data and convert it into business value for their business processes.

Article II investigates challenges and practices integrating service resources in a dynamic project environment. The purpose was to demonstrate that top-down mechanisms of project resource allocation need to be replaced by or supplemented with those that are more flexible. Previous studies have been concerned with resource competition between projects, placing project managers in a central role for resource allocation. The findings highlight prioritisation and adapting to change and delay as the main issues managers face when allocating resources to different types of projects and service activities within dynamic environments. As a key contribution, the article contends that resource allocation practices are context-dependent and suggested two more flexible approaches – hybrid resource allocation and bottom-up resource allocation – as examples of managing resource allocation in service units that engage in projects under uncertain conditions. Compared to a top-down perspective taken in previous research, both put forth practices involving broader personnel engagement in resource allocation tasks, drawing upon the experience of all employees.

Article III concentrates on the downstream value chain of project-based firms. Earlier research on the integration of different actors in project business has centred on the upstream value chain and a project-based firm's relationship with suppliers. The downstream delivery chain also includes an integration challenge - certain project-based firms use distributors to sell and deliver systems. The purpose of this paper was to highlight the importance of integrating with distributors in the delivery of complex systems. Various distributor capabilities were identified and grouped into business, relational, marketing, and delivery capabilities. Different integration mechanisms were mapped at the business and project levels, and divided into control-, cooperation-, and development-oriented mechanisms. The findings discussed how distributor capabilities related to complex system delivery are generated through repetitive collaboration across projects. The stable position of distributors in the downstream value chain facilitate the use of integration mechanisms at the business level and a development-oriented integration approach at the project level.

Article IV investigates the integration of services into the sales work of solutions and determines the requirements and practices for service-related selling of project-based firms. Effective solution sales is one prerequisite for a successful solution business, but little is known about the requirements for sales practices, particularly when services are integrated into solution offerings. The work specifies the nature

of service integration. The findings suggested using cooperation-oriented integration in sales work when adding services to a solution business at the project level. Moreover, internal integration between business units necessitates different control-, cooperation, and development-oriented practices, such as developing service sales know-how, transferring knowledge of service content and values, and employing a common information-sharing platform. The study reveals the work of practitioners to overcome problems arising from increased solution orientation. As a key contribution, the article supplies evidence of the requirements concerning sales work when integrating services into solutions and emphasises the complementarity of system and cross-functional integration in service-related solution selling.

2 LITERATURE REVIEW

2.1 Main concepts

2.1.1 Life-cycle solutions in project-based firms

Within industrial settings, customers have increasing demands for complete solutions and have required project-based firms to include services in their offerings (Kirsilä et al., 2007). Services, such as equipment maintenance, fault detection and correction, and condition monitoring have traditionally been provided in-house by the customer itself (Brady et al., 2005). Customer interest in procuring services from external suppliers has made project-based firms' offerings more diverse (Jalkala et al., 2010). Many equipment manufacturers offer a combination of products and services that together constitute a solution that delivers certain value to their customers (Kirsilä et al., 2007). The solution offering links the completed project to services and extends the project life cycle from the project delivery phase to post-project phase, when the solution is utilised by the customer (Aloini et al., 2013).

Service business and marketing management literature have reported different capabilities for solution development and delivery, such as knowledge-management capabilities (Oliva and Kallenberg, 2003), commercialisation and industrialisation capabilities (Storbacka, 2011), service-innovation capabilities (Kindström et al., 2013; Kindström and Kowalkowski, 2014), business model design (Visnjic et al., 2017),network-management capabilities (Parida et al., 2014), and value co-creation capabilities (Huikkola and Kohtamäki, 2017). These studies identified impacts of solution business on manufacturing firms' businesses, including achieving sustainable competitive advantages, differentiating from competitors, stable source of revenue, increased customer loyalty (Tuli et al., 2007; Kindström et al., 2012; Raddats, 2011). The literature has predominantly assessed the success factors of servitization with less analysis of challenges and particularly the impacts on the organisational boundaries (Jovanovic et al., 2016; Valtakoski, 2017).

Researchers have used several terms to refer to solution offerings that are partly overlapping. In general, solutions of project-based firms could be divided into

project-led solutions and life-cycle solutions. Project-led solutions complement project delivery with operational services. However, the main focus is still on the core delivery of the project. Life-cycle solutions integrate project delivery and service components to improve the life-cycle performance of the offering (Kujala et al., 2011). Services may take both a facilitating and value-adding role in project delivery, clearly supplementing the value offered to customers (Kujala et al., 2013). Thus, the solution can be divided into the core project, facilitating service products, and supporting service products (Kujala et al., 2013) that can be delivered separately or as an integrated offering (Kujala et al., 2010). This view of solution offerings that includes both products and services in different combinations implies that there are possibilities for the existence of a variety of business models for a project-based firm. Table 1 lists these terms and definitions.

Table 1. List of terms in previous literature that refer to solutions

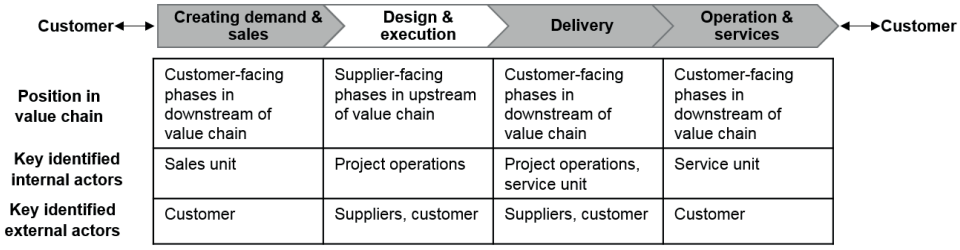
Term	Definition	Author(s)
Life-cycle solution	Bundle of project and service components, emphasising the life-cycle performance of the offering.	Kujala et al., 2011
Integrated solution	Bundle of systems, products, and services to deliver long-lasting deliverable and unique benefits to the customers	Gann and Salter, 2000; Brady et al., 2005; Davies et al., 2006; Huikkola and Kohtamäki, 2017
Service-enhanced/ service-led/service-intensive project	Large projects combined with a wide variety of services from basic maintenance to consulting	Alderman et al., 2005; Arrto et al., 2008; Ojansivu and Alajoutsijärvi, 2015
Complex product systems	Complex high-value products, systems, networks, capital goods, and constructs	Hobday, 2000; Davies and Brady, 2000
Turn-key solution	Comprehensive responsibility for systems integration, project management, cell planning, site construction, installation, technology upgrades, and after-sales support	Davies and Brady, 2000
Customer solution	Comprising four relational processes: customer requirements definition, customisation and integration of goods and/or services, their deployment, and post-deployment customer support	Tuli et al., 2007
Total solution	Service product or offering one-stop-shopping to customers	Matthyssens and Vandenbempt, 1998
Product service system	Combination of products and services into a system to deliver required user functionality in a manner that reduces the impact on the environment	Baines et al., 2007
Hybrid offering	Combining products and services into innovative offerings	Ulaga and Reinartz, 2011

This research follows Kujala et al.'s (2013) perspective on solution offerings of project-based firms and considers tangible product elements to increase project functionality and intangible service elements to respond to specific customer needs and, together, creating value for a customer's process. The current work employs the term "life-cycle solution" as bundle of project and service components and the focal point is not limited to additional service components, such as commissioning and handover, but stresses long-term operational responsibility from the project-based firm during the solution life cycle (Kujala et al., 2011).

2.1.2 Downstream value chain in solution delivery

Project-based firms that offer life-cycle solutions cannot follow traditional value chains that originate in own assets and capabilities and lead to the delivery of products or services for customers (Davies, 2003, pg. 326), and instead work in a dual upstream-downstream value chain (Jalkala et a., 2010). On the one hand, the firms need to venture upstream to acquire knowledge, expertise, and components to reach the goal of system integration. On the other hand, firms must look downstream to understand specific needs of customers, design the solutions accordingly, and deliver services.

When expanding their focus from project delivery to customer-solution usage, project-based firms have to consider the service-oriented offerings at the front end of a project. The increasing inclusion of services within solutions implies that project-based firms are more closely involved in their customers' businesses and processes (Oliva and Kallenberg, 2003) and are "going downstream" (Wise and Baumgartner, 1999). These life-cycle solutions affect the business of project-based firms in terms of increased share of the customers' businesses, more responsibility for long-term success, more opportunities to maximize profit, and covering a large portion of the value stream (Kujala et al., 2011). However, this is not only about delivering services, but how services are integrated in the offering to provide a solution that creates more values for the customer (Davies, 2003, pg. 321). Therefore, exploring the downstream value chain requires more attention by project-based firms involved in solution business. Figure 4 illustrates the actors involved in the supplier-facing phases and customer-facing phases based on the extant literature.



Position in value chain	Customer-facing phases in downstream of value chain	Supplier-facing phases in upstream of value chain	Customer-facing phases in downstream of value chain	Customer-facing phases in downstream of value chain
Key identified internal actors	Sales unit	Project operations	Project operations, service unit	Service unit
Key identified external actors	Customer	Suppliers, customer	Suppliers, customer	Customer

Figure 4. Key internal and external actors of a project-based firm's value chain

The previous studies have predominantly assessed the upstream value chain by investigating the requirements of system integration, collaboration and integration with suppliers, and delivering the core project (Ahola et al., 2017). There are few studies that concentrate on the requirements of integration of projects and services in customer-facing processes, including solution sales (e.g., Storbacka, 2011) and service delivery (e.g., Artto et al., 2015). Furthermore, while previous studies highlighted the necessity to study the relationships with key actors in the project milieu more broadly (Cova and Salle, 2005), research on the intermediaries between the firm and customer to establish what they can bring to the value chain and how they can be integrated in project business successfully is lacking.

2.1.3 The concept of integration and integration practices

The word "integration" originates from the Latin word *"integrationem"*, which means renewal and restoration. Integration has been used in different contexts and has become a vague concept in terms of definition. The American Heritage Dictionary provides two definitions of integration that, while similar, have different characteristics. The first definition, in line with other dictionaries (e.g., the Oxford English Dictionary), describes integration broadly as "the action or process of integrating". Here, integrating encompasses a broad range of actions, such as making up, combining, coordinating, blending, unifying, consolidating, merging, etc. The second definition defines integration as "the state of becoming integrated". While the first definition has a dynamic nature and considers integration as a process, the second one has a static nature and considers integration as a goal to achieve. The concept of service integration in the present study encompasses both forms of integration. While integration of offering is a state of integrated projects and services, organisational integration is not a static goal to reach but a process including different activities and parameters (Kirsilä et al., 2007).

Achieving the unity of efforts (Lawrence and Lorsch, 1967) is the distinction of integration with other interchangeable concepts, such as coordination or cooperation, which mainly focus on working together and joint actions. The concept of organisational integration is varied in different disciplines (Kirsilä et al., 2007) depending on the activities and components that are studied in that domain, such as strategy management, supply management, information systems, etc. The diverse definitions of integration refer to the coordination of different departments, different activities of a specific process, information and material flow, or information technologies (Barki and Pinsonneault, 2005). As a general and broad conceptualisation, Barki and Pinsonneault, (2005) defined organisational integration as "the extent to which distinct and interdependent organisational components constitute a unified whole". Depending on the domain of the study, the components could be organisational units, partners, business processes, people, technology, etc.

The existing literature on supply chain integration provides several definitions and perspectives regarding organisational integration. While some studies have been concerned exclusively with external integration, others have addressed both internal and external integration (Schoenherr and Swink, 2012). The supply chain integration literature has dealt with three building blocks, namely internal integration, supplier integration, and customer integration. Following the definitions of previous studies that considered both intra- and inter-perspectives, organisational integration is defined as collaborative management of intra- and inter-organisational interfaces (Flynn et al., 2010; Schoenherr and Swink, 2012).

Organisational integration takes place through different integration practices. A clear definition of practice is difficult to arrive at, mainly because practices should be defined in their specific context. In this work, practices are "the coordinated activities of individuals and groups in doing their real work as it is informed by a particular organisational or group context" (Brown and Duguid, 1991). In line with these definitions, integration practices are sets of actions that are conducted by the firm to achieve an effective and efficient flow of information, material, money, and decisions within and at the firm's boundaries in order to elicit enhanced customer value (Flynn et al., 2010; Schoenherr and Swink, 2012). Practice is always situated in time and place (Adler and Pouliot, 2011), meaning that practices are not developed at a specific point of time, but they are always shaped by the conditions of particular sites and at particular moments (Kemmis et al., 2012). Moreover, practices are socially developed through learning and training (Corradi et al., 2010). This study adopts the viewpoint of research fields like strategy-as-practice and project-as-practice and sees practice as an empirical object; therefore, practice becomes the

level of analysis at which to study the activities of the practitioners (Corradi et al., 2010).

Returning to the context of project-based firms, delivering solutions in a project-based firm involves a broader network with higher complexity and necessitates integration of suppliers and customers into the delivery process (Kirsilä et al., 2007). Solution delivery that includes service delivery creates a new vision in the solution provider's business, which is different than delivering solely a new technology or product, and that vision must be communicated and implemented inside the organisation as well as within the interfaces that feature external actors (Alderman et al., 2005). Service integration in project business can be divided into two categories: 1) offering-related integration, in terms of integration of projects and services; and 2) organisational integration, with respect to integration of internal and external actors within the value chain. The solution providers combine integration of projects and services with value chain integration to provide solutions (Kirsilä et al., 2007). Sections 2.2 and 2.3 will discuss these two aspects of service integration in more detail.

2.2 Integration of offerings

2.2.1 Integration of services with solution offerings

Changing orientations in project business, such as changing from project orientation towards customer orientation, customer-oriented delivery and implementation, and a dual upstream-downstream movement of project suppliers (Jalkala et al., 2010) raises the importance of service orientation in project-based firms (Burström et al., 2013). Project-based organising is particularly suited for combining goods-centric offerings with service-centric offerings in complex products and systems (e.g., Gann and Salter 2000, Hobday 2000). This trend, called "servitization", is "the innovation of organisation's capabilities and processes to better create mutual value through a shift from selling products to selling product-service systems" (Baines et al., 2009). There are several reasons to integrate services and goods: achieving additional revenue from the installed base of equipment, having a more reliable source of revenue, responding to customers' increased needs for services, reducing the chances of imitation from competitors (Oliva and Kallenberg 2003), facilitating the sale of products, balancing the effects of economic cycles, improving customer

relationships, and creating growth opportunities in mature markets (Brax, 2005). Various project-related services can be offered for customers before, during, and after the project to enhance the project-based firm's business (Artto et al., 2008). Common examples of project-related services include consulting, design and development, training, maintenance, optimisation, modernization, financing, and information support (Artto et al., 2008).

Table 2 outlines the core areas of servitization that have been studied in the project business literature. Project-related services create different "impact types" on the business of a project-based firm and have complex interrelationships with the business model and revenue generation logic of a project-based firm (Artto et al., 2008). The business potential of project-related services has been explored and characterised in previous research (Kujala et al., 2013). When adding intangible components into technology-based offerings and complementing the temporary project with continuous service operations, project suppliers face a new logic for value creation (e.g., Kujala et al., 2010) and require new capabilities (Davies and Brady, 2000; Davies et al., 2007). Wikström et al. (2009) proposed two elements that considerably influence the potential for including services in a project-based firm's business model: the complexity of the core project delivery and the firm's degree of maturity in delivering services. Previous research suggests manufacturing firms develop solution-specific business models (Kujala et al., 2010), consider systems integration as the firm's core capability (Davies and Brady 2000, Davies et al. 2006), and take into account the role that services have played when choosing the business model (Kujala et al., 2011). Services have been noted to contribute to the performance dimensions relevant to project-based firms in a variety of ways (Kujala et al., 2013). Solution-specific business models have been built primarily upon the value proposition for the customer and revenue logic for the project-based firm. Researchers have also acknowledged the firm's network position and capabilities as key components in solution-specific business models (e.g., Kujala et al., 2010). Recent studies on servitization and service-dominant logic in project business shows that project-based firms must understand the project purpose by defining the value of the project in use (Smyth, 2018) and illustrates that co-creation of value at the front end of projects leads to value realisation in practice (Smyth et al., 2018). Projects should not be just be limited to time, cost, quality, and scope criteria, but need to be formulated as service provision, which requires defining customers' long-term value during the early phase of the project (Smyth et al., 2018; Fuentes et al., 2019).

Table 2. Core areas of integrating services into projects within the mainstream project management literature

Author(s)	Research method and context	Key findings
Artto et al. (2008)	Case study with five industrial project and service suppliers	• Identification of six impacts of services on the business of a project-based firm • Different services are offered at various stages of the solution life cycle (before, during, and after the core project) • Identification of several enablers of and barriers to including services in a firm's business
Wikström et al. (2009)	Case study with six industrial project and service suppliers	• The complexity of the core project delivery and the firm's degree of maturity in delivering services recognised as main contributing factors in defining business logics • Identification of various business logics among project-based firms
Jalkala et al. (2010)	Case study with six industrial project and service suppliers	• Identification of changing orientations in project business
Kujala et al. (2010)	Single embedded case study with five solution deliveries of a power company	• Identification of five solution-specific business models • The business models of project-based firms must be also analysed at the solution level • Lack of integration between project and service units leads to product-centric value propositions and decreases the total value for firms and customers
Kujala et al. (2011b)	Single case study with a power plant supplier firm	• The choice of the business model was mainly related to customers and not project-based firms • Identification of factors that impact the choice of business models
Kujala et al. (2013)	Case study with three industrial project and service suppliers	• Identification of the role of services in solution delivery, including core project delivery, facilitating service products, and supporting services products • Identification of the effect of services on the business of project-based firms in terms of strategic, financial marketing and sales, and project implementation perspectives • Project-based firms need suitable organisational arrangements to facilitate information sharing between sales and service operations to leverage the potential benefits of adding services to a solution offering
Ojansivu and Alajoutsijärvi (2015)	Comparative case study with a wind turbine parts supplier and a content management system supplier	• There were inbuilt tensions among typical occupational groups in service-intensive projects • Post-project business relationships were dynamic and consisted of passive and active stages • Organisational challenges of service-intensive projects • Adding services to the projects required a proactive approach to determine customer needs
Smyth (2018)	Conceptual study	• Highlighting projects as preconditions for other operational activities • Identification of a taxonomy of six categories of preconditions
Smyth et al. (2018)	Case study with a mega project	• Defining value as a co-created value proposition at the front end of the project that becomes applicable during the realisation stage • Highlighting the long-term issues regarding realisation of value and so extending decision-making beyond traditional project dimensions
Fuentes et al. (2019)	Case study with six project cases in two public sector organisations	• The value outcome is delivered in the latter stages of a project but developed during the early phases • Identification of co-creation practices to enhance value outcomes from customers' perspectives in the medium- and long-term • Identification of tensions surrounding co-creation processes that need to be addressed by managers to assure value outcome

Many important contributions have been made with respect to the services in the project business discipline, and the focal point has been primarily strategic and from a top-down perspective. There have been few studies (e.g., Artto et al., 2015) that have taken the bottom-up perspective and focused on incorporating projects and services at the operational level. These studies have offered qualitative evidence regarding project-related services for different project-based firms, particularly within the engineering industry. However, researchers have directed less attention to delivery models and enablers for efficient project-related service business. It is evident that services will call for new capabilities in systems integration and solution selling for supplier firms (Davies and Brady, 2000; Davies et al., 2007). The marketing and customer interface routines may also require changes when adding services to project-related offerings (Lenfle and Midler, 2009). As value creation in services may occur in tight collaboration between the supplier and customer, their processes and practices in service delivery must be aligned (Grönroos, 2008; Grönroos and Helle, 2010). Modern technical systems were identified as a driver of intensified customer cooperation (Wikström et al., 2009), but they have yet to be adequately studied from the viewpoint of project business.

2.2.2 Challenges associated with adding services to life-cycle solutions

Prior studies on life-cycle solutions and the use of services within project-based firms have analysed the benefits and opportunities of integrating projects and services and development of related capabilities. So far, however, there has been little research on the challenges and obstacles in implementing integration strategy. The main challenges acknowledged in the literature include increased complexity, product-centric mindset, and separate business.

Integrating projects with services increases project complexity in terms of structural complexity (elevated number of stakeholders) and uncertainty (lack of clarity in project goals) (Alderman et al., 2005). The shift towards life-cycle solutions raises project complexity; more elaborated project network with increased number of actors, structural complexity owing to interaction and interdependence between the many elements and actors, uncertainty drives from unclearness of project goals and the means to achieve them (Alderman et al., 2005). Furthermore, the implementation of advanced ICT systems has received more interest from the perspective of manufacturing firms' operations. However, introducing ICT-based

solutions can again increase complexity by adding uncertainty regarding creating business value through these advanced technologies. Previous studies have acknowledged that manufacturing firms struggle with different challenges in utilising ICT-based solutions as well as convincing customers to accept and implement such technology (Jonsson et al., 2008; Westergren, 2011; Westergren and Holmström, 2012).

The researchers also recognised the issue of path dependency in transforming manufacturing firms into solution providers (Huikkola and Kohtamäki, 2017). The product-centric mindset can be a barrier for firms developing capabilities for integrating, selling, and delivering solutions (Huikkola and Kohtamäki, 2017). Previous studies have underscored the need for a cultural change in the firms that were traditionally selling only products (Neto et al., 2015). The product-dominant logic requires different behaviour and organisational culture and thus the firms pursuing offering solutions must unlearn previous lessons learned related to selling only products and learn new skills while establishing a new culture around service-dominant logic (Huikkola et al., 2016). Accordingly, developing new capabilities is highlighted in previous studies. Identifying and developing strategic capabilities that enable firms to provide solutions have been increasingly important for industrial solution providers (Huikkola and Kohtamäki, 2017). Life-cycle solution providers generate several capabilities, including interrelated strategic, project, and functional capabilities (Davies and Brady, 2000), system integration (Hobday et al., 2005), operational service, business consulting, and financial capabilities (Brady et al., 2005) as well as different operational capabilities, such as strategy planning, management systems, infrastructure support, and human resource management (Storbacka, 2011). The practices identified in relation to the required capabilities for solution selling and delivery are often limited to pointing out the required practices instead of exploring their constitution and implementation. For example, for a sales force, the shift towards solutions necessitates consulting capabilities (Brady et al., 2005), value quantification, solution configuration (Storbacka, 2011), and value-based selling (Hellström et al., 2016).

Challenges associated with separate business units in providing solutions have been identified in a number of studies (Artto et al., 2015). The integration of project business and service business is a frequently mentioned issue in solution selling and delivery and has mainly been reviewed at the firm level, pointing to the necessity of interactions between functional units. Previous studies on life-cycle solutions have demonstrated that sales and proposal making depend on different cross-functional skills because a firm must decide how to tailor its products and services to resolve

customers' specific problems and ensure value creation through integrating products and services (Artto et al., 2015; Brady et al., 2005; Storbacka, 2011). Providing post-project services also produces challenges regarding cooperation between buyers and sellers with respect to conflicting goals and coordination to communicate and synchronize activities (Ojansivu and Alajoutsijärvi, 2015). The issue of cross-functional coordination in delivering solutions leads to concerns about knowledge management, especially during the period of transition of projects from a project team to the permanent organisation (Gann and Salter, 2000).

When examining the level of analysis of the solution literature, it is noticeable that the majority of empirical studies are at a macro level: organisations or networks (e.g., Davies and Brady, 2000; Brady et al., 2005; Davies et al., 2006; Artto et al., 2008; Kujala et al., 2013). However, recent research concerning the supply chain integration or information processing perspective has changed the level of analysis to the project level and explored micro-level integration practices at different organisational interfaces (e.g., Turkulainen et al., 2013; Artto et al., 2015; Ståhle et al., 2019). In order to characterise the implications of service integration in the downstream value chain of project-based firms, this study takes the micro-level perspective and studies service integration at the practice level.

2.3 Organisational integration

2.3.1 Need for actors' integration in project-based firms' value chains

Project-based firms in the international field require various business relationships within the wider environment (Skaates and Tikkanen, 2003). These business relationships deal not only with the project itself but also with business more generally as the relationship between actors must continue even after projects are completed (Hadjikhani, 1996). From the life-cycle solution point of view, the projects are not solely short-term project deliveries but include the operations of systems (Kujala et al., 2010). A project-based network is different than a traditional manufacturing network, which has a clear focus on the buyer-seller relationship, and requires coordination mechanisms between multiple firms and managing complex interfaces (Gann and Salter, 2000). Project-based firms need to cooperate with various actors within their global network (Skaates and Tikkanen, 2003) and integrate multiple organisational units and geographies (Turkulainen et al., 2015) during

project delivery and between projects. An important question for project-based firms is how they can integrate the capabilities of internal and external actors and apply them effectively in their project business.

Establishing a suitable organisation to deliver solutions is one of the primary challenges for solution providers (Galbraith, 2002). Previous studies argued that especially during the early stages of a project, there is a need for a multi-skilled and cross-functional team to develop a proposal that ensures meeting different expectations of customers (Brady et al., 2005). Alderman et al. (2005) argued that sense-making assists in understanding different meanings of the project for different project actors. Identifying varying perspectives on projects and managing them through building consensus is crucial for success in project business. Earlier works have stressed using relational processes across the organisation and its boundaries to develop, sell, and deliver solutions (Huikkola and Kohtamäki, 2017). Thus, adding services to solutions requires an appropriate type of organisational arrangements that facilitates information- and knowledge-sharing between internal units, such as service and sale units (Kujala et al., 2013). With this, research on actual implementation of organisational settings that support solution business has been limited (Kujala et al., 2013).

Project management does not only deal with internal organisation, but managing inter-organisational integration becomes paramount for solution business (Kirsilä et al., 2007). Accordingly, previous studies have explored inter-organisational relationships during solution delivery. Analysing the unit of analysis of the previous studies show that the majority of the empirical studies on solution business have focused their analysis on upstream value chain of project-based firms and explored integration mechanisms during manufacturing and system integration phases (e.g. Martinsuo and Ahola, 2010; Ahola et al., 2017). Findings show that the strategic shift toward life-cycle solutions modifies the supply chain configuration in order to enable the adoption of the new strategy, collaboration practices, and revenue-sharing among firms (Aloini et al., 2013). Previous studies on supply chain integration in project-based firms has provided valuable findings at practice level that will be further explained in section 2.3.3.

Reflecting on the broader literature on supply chain integration shows that the value chain of a firm has multiple vertical and horizontal linkages that imply the need for knowledge and resource management inside the firm and across firm boundaries (Swink et al., 2007). Previous studies have recognised different forms of internal and external integration and their effects on each other as well as organisational performance (Droge et al., 2004; Germain and Iyer, 2006; Swink et al., 2007). Internal

integration implies cooperative work among varied functions and departments within a firm (Ahola et al., 2017). External integration implies integrated control of functions and processes among business actors (Germain and Iyer, 2006) in upstream and downstream value chains. The upstream integration research predominantly assessed supplier and contractor integration within manufacturing firms (Droge et al., 2004; Zhao et al., 2011). Studies on downstream integration examined collaborative relationships between firms and customers (Germain and Iyer, 2006).

The literature on supply chain integration has recognised the importance of considering both internal and external perspectives to maximize supply chain value for all involved actors (Flynn et al., 2010). Previous investigations of supply chain integration have acknowledged the need for internal integration among different functions to support upstream processes. External integration in upstream value chains, i.e., supply chain integration, is not restricted to inter-organisational relationship between the firm and the supplier but it involves internal integration as well (Schoenherr and Swink, 2012). Internal integration enables external integration (Flynn et al., 2010) by facilitating flow of products, services, information, money, and decisions to increase customer value (Zhao et al., 2011; Ahola et al., 2017) at low cost and high speed (Flynn et al., 2010).

2.3.2 Internal integration within project-based firms

Internal integration involves cross-functional collaborative and information activities through synchronized processes and systems (Schoenherr and Swink, 2012). While the organisational structure is based on functions and specialisation, processing customer orders encompasses different functions and processes (Flynn et al., 2010). Internal integration emphasises the need for integrated processes across different functions within a firm instead of functional silos (Zhao et al., 2011). These synchronized processes have the objective of meeting customers' needs as well as enabling interaction with suppliers (Flynn et al., 2010), i.e., facilitating external integration. Internal integration mainly features information system integration and cross-functional cooperation (Zhao et al., 2011). There are several advantages of internal integration derived from enhanced information processing capabilities (Gemser and Leenders, 2011) and flexibility in utilising resources (Ford and Randolph, 1992) as well as disadvantages because of undesired psychosocial

outcomes (Gemser and Leenders, 2011), such as increased ambiguity and conflicts (Ford and Randolph, 1992).

Various previous studies have taken the theoretical lens of information processing system and applied Galbraith's (1973) and Tushman and Nadler's (1978) model of organisation to study contextual factors that affect integration needs. The level of integration can be varied between different organisations and projects. For example, Turkulainen et al. (2013) identified uniqueness, ambiguity, complexity, and dispersion as important factors for determining the need for integration. In general, the existing literature employs level of novelty (i.e., uncertainty and equivocality) and analysability as important criteria when choosing integration mechanisms (Adler, 1995; Sicotte and Langley, 2000). The use of integration mechanisms were not reported to have a positive impact on performance of the projects with low uncertainty and equivocality (Sicotte and Langley, 2000). Cross-functional integration becomes more imperative with projects with high levels of technological and market risk (Gemser and Leenders, 2011). Moreover, obstacles can hinder internal integration within an organisation, such as differences in personalities, training and background, work-related languages, priorities and responsibilities, separated physical locations, lack of trust or respect, lack of formalised communication structures, and inadequate managerial support (Griffin and Hauser, 1996; Song et al., 1996).

Table 3 summarises the findings from the literature review on internal integration at project-based firms. The few studies in system delivery project contexts explored integration at sales-project (Turkulainen et al., 2013; Ståhle et al., 2019) and project-service (Artto et al., 2015; Ståhle et al., 2019) interfaces. The creation of formal internal and external relationships, the provision of value-added services, and the promotion of a life cycle perspective are among the main mechanisms theorised to enhance solution integration at a project-based firm (Artto et al., 2015). The previous studies mainly explored integration from the perspective of customer relationship management and there exists a gap regarding studying how people at a solution-provider firm experience integration and how the firm responds to requirements of the integration tasks.

Table 3. Empirical studies on internal integration in project-based firms

Author(s)	Research context and method	Major findings
Kraut and Streeter, 1995	• Survey among 65 projects at one large software development firm • Software development project • Project-level analysis	• Projects used formal, impersonal practices more when projects were certain, larger, and after the design phase • Projects used formal and informal interpersonal practices more when projects were certain, larger, and in the planning phase • Projects used electronic communication more when projects were dependent on input from other groups
Adler, 1995	• Case study with 13 firms in electrical and mechanical engineering domains • New product development project • Firm-level analysis	• Identification of different integration practices divided into standards, schedules and plans, mutual adjustment, and teams for pre-project, product and process design, and manufacturing phases
Sicotte and Langley, 2000	• Cross-sectional survey of 121 R&D projects in a research laboratory • New product development project • Project-level analysis	• Depends on the level of uncertainty and equivocality, different types of integration mechanisms were required • Integration mechanisms were most effective for performance of high uncertainty or equivocality projects
Adenfelt, 2010	• Single case study of a transnational product development project • New product development project • Project-level analysis	• Identification of two meanings for knowledge-sharing; first, sharing of knowledge by coordination and communication, and second, shared knowledge as a foundation for sharing knowledge • Using integration practices were dependent on organisational context
Enberg et al., 2010	• Single case study with a manufacturer of power generation equipment • New product development project • Project-level analysis	• Introducing the concept of segregated team instead of fully integrated team; team consists of experienced and less experienced project members to save time and money associated with expensive communication mechanisms • Knowledge-sharing between experiences and less experienced project members is not equal
Turkulainen et al., 2013	• Single case study with a global automation system supplier firm • System delivery project • Project-level analysis	• Integration needs between project sales and project operation varied depending on contextual factors • Different integration mechanisms were used across project phases
Artto et al., 2015	• Embedded case study with four projects of a supplier in process industry • System delivery project • System-level analysis	• Identified eight micro-level integration mechanisms and categorised them into customer relationship overlaps, enhanced internal relationships, and life-cycle perspective mechanisms • Integration between project and service units enhanced customer relationship management over the system life cycle
Ståhle et al., 2019	• Single case study with a solution provider in waste-to-energy process industry • System delivery project • System-level analysis	• Defined four types of integration practices, including meetings, IT systems, personal involvement, and processes and rules • The main integration practices between sales and service units were based on personal involvement • Identified the necessity of integration and managing customer information flow between sales and service units

The previous literature in operations and manufacturing have evaluated sales-manufacturing interfaces and addressed the need for integration across functions to deliver value to customers (Piercy and Lane, 2003; O'Leary-Kelly and Flores, 2002). While the results of mainstream operation literature could be helpful for understanding the benefits and requirements of integration, the specific characteristics of project-based firms need particular attention. In contrast with the manufacturing industry and new product development, project-based firms that deliver life-cycle solutions require accurate customer information and cannot rely exclusively on the assumptions or forecasts of customer requirements (Ståhle et al., 2019). Findings from prior studies on integration at the interface of sales and project operation exhibit conflicts among goals and expectations of each business unit and the need for integration to ensure steady flow of work, maintaining highly utilized resources, and delivering project results within promised schedules (Cooper and Budd, 2007). Contrary to cross-functional integration in standard operation, different integration mechanisms are utilised during each temporal phase of a project (Turkulainen et al., 2013).

Internal integration requires both formal and informal communication and collaboration across functional boundaries (Kraut and Streeter, 1995). Prior studies employed different categorisation systems to divide integration practices based on the goal and context of the research (Adler, 1995; Kraut and Streeter, 1995; Turkulainen et al., 2013). Table 4 makes a distinction between *control-oriented* (e.g., standardized work procedures, rules, policies, and manuals) and *cooperation-oriented* (e.g., meetings, teams, trainings, committees, and integrators) integration practices (in line with Martinsuo and Ahola, 2010; Turner and Müller, 2004). Previous studies on new product development projects have explored internal integration practices, mainly at the interface of technical functions and R&D and marketing. Some studies on system delivery also identified several practices at the interface of project operations and sales, and project operations and services.

Table 4 describes how while cooperation-oriented practices are actively used at all interfaces, project-based firms use more control-oriented practices, such as standard procedures, rules, kick-off meetings, etc. when collaboration follows a sequential and reciprocal process, such as at the interfaces of technical functions to deliver a project, R&D and marketing to deliver a new product, and project operations and sales to transition the project to the execution phase. However, the integration between project operations and services more relies on cooperation-oriented practices to share knowledge and information while promoting life-cycle views for the customers.

Table 4. Summary of internal integration practices at project-based firms

Integration practices	Author(s)
Interface of technical functions	
Control-oriented practices:	
Meetings to review requirements and status	Kraut and Streeter, 1995; Adenfelt, 2010
Kick-off meetings	Adenfelt, 2010
Data dictionaries	Kraut and Streeter, 1995; Adenfelt, 2010
Planning and process specification	Kraut and Streeter, 1995; Sicotte and Langley, 2000
Formal leadership	Sicotte and Langley, 2000
Project management database	Adenfelt, 2010
Collective goals	Adenfelt, 2010
Cooperation-oriented practices:	
Unscheduled group meetings	Kraut and Streeter, 1995
Co-location	Kraut and Streeter, 1995; Enberg et al., 2010
E-mail and electronic bulletin boards	Kraut and Streeter, 1995; Adenfelt, 2010
Cross-functional project teams	Sicotte and Langley, 2000; Enberg et al., 2010
Information systems	Sicotte and Langley, 2000
Core integrators	Sicotte and Langley, 2000; Enberg et al., 2010
Sense-making at project meetings	Enberg et al., 2010
Interface of R&D and marketing	
Control-oriented practices:	
Standards and rules	Adler, 1995
Exception resolution plans	Adler, 1995
Incentives and rewards	Griffin and Hauser, 1996
Formal integrative management processes	Adler, 1995
Design review meeting	Griffin and Hauser, 1996
Cooperation-oriented practices:	
Coordination committees	Adler, 1995
Joint development and teams	Adler, 1995; Griffin and Hauser, 1996
Transition teams	Adler, 1995
Co-location	Griffin and Hauser, 1996
Personnel movement across functions	Griffin and Hauser, 1996
Interface of project sales and project operations	
Control-oriented practices:	
Formal kick-off meeting to start the execution	Turkulainen et al., 2013; Ståhle et al., 2019
Cross-functional kick-off meeting	Turkulainen et al., 2013
Standard procedures for the sales and operations	Turkulainen et al., 2013
Standard review of project details and status	Turkulainen et al., 2013; Ståhle et al., 2019
Formal transition from sales to operations	Turkulainen et al., 2013; Ståhle et al., 2019
Cooperation-oriented practices:	Turkulainen et al., 2013
Integrator role to transfer technical knowledge	Turkulainen et al., 2013
Formal and informal cross-functional meeting	Turkulainen et al., 2013; Ståhle et al., 2019
Co-location	Turkulainen et al., 2013
Interface of project operations and services	
Control-oriented practices:	
Selection of project manager	Artto et al., 2015
Kick-off meeting	Ståhle et al., 2018
Cooperation-oriented practices:	
Creation of formal relationship between the service unit and customer	Artto et al., 2015; Ståhle et al., 2019
Use of cross-unit resources	Artto et al., 2015
Participation of service unit in system design	Artto et al., 2015
Provision of value-added services and life-cycle perspective by service unit during project delivery	Artto et al., 2015
Formal or informal personal involvement and discussions	Ståhle et al., 2019
Sharing business opportunities between units	Ståhle et al., 2019

It can be concluded that integration practices can vary depending on the context (Kraut and Streeter, 1995; Trautmann et al., 2009) and effects on performance are contingent and context-dependent (Turkulainen and Ketokivi, 2012; Tsai and Hsu, 2014). For example, the use of IT systems were reported more in new product development projects than system delivery projects. Size of projects may also affect the choice of integration practices; a large project requires more formal integration mechanisms across functions to control different groups involved in the project or a project with higher uncertainty needs more informal, interpersonal integration mechanisms, such as co-location and informal group meetings (Kraut and Streeter, 1995).

2.3.3 Supplier integration practices

Supplier integration involves supportive, collaborative, and information-sharing activities between the firm and suppliers that enable the firm to plan and manage internal processes through understanding suppliers' processes, capabilities, and limitations (Schoenherr and Swink, 2012). Supplier integration can be demarcated into two main approaches: supplier development and supplier partnering (Droge et al., 2004). Firms that recognise the important link between suppliers' performance and the performance of their own organisation and offerings try to facilitate supplier performance by developing suppliers' capabilities through evaluation, site visits, training and certification programmes, and so on (Droge et al., 2004). However, supplier partnering is not limited to development activities but involves suppliers during early stages of the product life cycle to ensure utilising supplier input and their capabilities in other processes, like product design (Droge et al., 2004). The collaborative activities in supply chain integration help the firm and suppliers jointly resolve problems and facilitate operations (Zhao et al., 2011). Table 5 lists supplier integration practices suggested in the project-based firm literature.

As can be seen in Table 5, the majority of prior studies explored integration with sub-contractors and component suppliers in construction and infrastructure projects (e.g., Errasti et al., 2007; Hietajärvi et al., 2017) with fewer studies on integration with suppliers in system delivery projects (e.g., Martinsuo and Ahola, 2010; Ahola et al., 2017).

Table 5. Empirical studies on supplier integration within project-based firms

Author(s)	Research context and method	Major findings
Errasti et al. (2007)	• Action research on two subcontractors • Construction project • Design and execution phases • Business-level analysis	• Introducing a supplier integration tool • Focusing on fewer suppliers and implementing a partnership development process improved business in the construction industry • Involving suppliers at the product-design stage saved on costs and improved quality
Martinsuo and Ahola (2010)	• Case study of two projects in the engineering and shipbuilding sectors • System delivery project • Execution phase • Project-level analysis	• Categorising integration mechanisms into control-oriented and cooperation-oriented • Configuration of supplier integration across different buyer-supplier relationships
Cheung and Rowlinson (2011)	• Case study with 27 contracting organisations of a public sector organisation • Infrastructure projects • Execution phase • Project-level analysis	• Alignment between organisational culture and structure affected commitment of staff in partnership with suppliers • Education and training were important elements in implementing successful supplier integration
Davies and Mackenzie (2014)	• Single case study on a construction programme • Construction project • Design and execution phases • Project-level analysis	• To decrease complexity, project was divided into sub-systems with clearly defined interfaces with other systems • To respond to uncertainty and changes, the programme and change control processes were standardized • Integrative teams and committees were actively used to endure system integration
Aagaard et al. (2015)	• Case study of 15 sub-contractors within the offshore wind power energy sector • Construction and maintenance project • Execution phase • Business-level analysis	• Informal coordination was enhanced by trust building, previous experience with sub-contractors and possibility of future projects, clear expectations on informal coordination, developing contracts in favour of both parties
Martinsuo and Sariola (2015)	• Case study of three component manufacturing firms in construction industry • Construction project • Execution phase • Business-level analysis	• Third-party expectations were identified and categorised into knowledge-based, project-related, development-oriented, and relationship-oriented • Component supplier benefited from relationship through increased bargaining power with main contractor • Third parties benefited from relationship through deriving new knowledge, new solutions, and long-term development cooperation and pilot projects
Ahola et al. (2017)	• Single case study of a systems integrator, delivered a complex subsea transformer • System delivery project • Design and execution phases • Project-level analysis	• Both system integrator and suppliers participated in cross-organisational integration activities • Selection of integrative activities were based on involved actors' priorities amongst time, cost, and scope objectives
Hietajärvi et al. (2017)	• Case study of a complex tunnel construction project and railway renovation project • Infrastructure projects • Design and execution phases	• Integration mechanisms in construction project affected by dynamic environment • Integration mechanisms were changed owing to project life-cycle phase, unexpected events, and learning process

Literature on contactor management emphasises the benefits of integration, including information sharing among actors (Khalfan and Maqsood, 2012), generating a knowledge-management system (Khalfan and Maqsood, 2012; Nesheim and Hunskaar, 2015), and supporting innovation (Badi and Pryke, 2015). Previous research underscores the role of the focal firm in helping suppliers develop their capabilities over long periods (Martinsuo and Ahola, 2010). To develop and integrate capabilities, project-based firms must transfer and retain knowledge, encourage a social network, appraise the supplier's/contractor's performance, create a capability development group (Taylor et al., 2015), and cooperate informally across suppliers/sub-contractors (Aagaard et al., 2015).

Literature has revealed various integration practices at the interface of the firm and contractors and suppliers. Table 6 presents a summary of the integration practices and divides them into control-oriented or cooperation-oriented practices. Prior studies on integration in a construction context have acknowledged the critical role of information and communication technologies, such as common document storing (Hietajärvi et al., 2017) and implementing different technological systems and platforms (Cheung and Rowlinson, 2011; Davies and Mackenzie, 2014) to facilitate sharing information and knowledge throughout the supply chain. The use of IT was not acknowledged in system delivery context. Meanwhile, project-based firms employed several control-oriented practices, such as shared goals, agreements, procedures, etc., to integrate with contractors, and prior research on system delivery projects directed plenty of attention to cooperation-oriented practices, such as integrative teams, formal and informal meetings, co-location, and joint problem-solving (Martinsuo and Ahola, 2010; Ahola et al., 2017).

In summary, the macro perspective has been the dominant approach in previous studies on supplier integration with life-cycle solution providers and few studies examined integration from a micro perspective (e.g., Martinsuo and Ahola, 2010; Ahola et al., 2017). Most of the identified integrative activities are short-term and related to a specific project (Ahola et al., 2017). However, certain identified activities, such as training and formal collaboration agreements (Martinsuo and Ahola, 2010), imply a more long-term and business-related approach. It has also been acknowledged that supply chain integration practices of project-based firms are context-specific and thus integration practices could very among different cases and industries (Ahola et al., 2017).

Table 6. Summary of supplier integration practices

Integration practices	Author(s)
With contractors and third parties in construction projects	
Control-oriented practices:	
• Developing suppliers' quality systems	Errasti et al., 2007
• Information-sharing procedures	Cheung and Rowlinson, 2011
• Reporting procedures	Davies and Mackenzie, 2014; Hietajärvi et al., 2017
• Control contractors' performance	Davies and Mackenzie, 2014
• Written agreements and adjustments to contracts	Errasti et al., 2007; Aagaard et al., 2015
• Shared project goals	Hietajärvi et al., 2017
• Performance incentives	Hietajärvi et al., 2017
• Processes for collaborative working	Hietajärvi et al., 2017
• Organisation chart and job descriptions	Hietajärvi et al., 2017
Cooperation-oriented practices:	
• Collaborative process in design and development	Errasti et al., 2007; Martinsuo and Sariola, 2015; Hietajärvi et al., 2017
• Building personal relationships	Cheung and Rowlinson, 2011; Martinsuo and Sariola, 2015; Hietajärvi et al., 2017
• Training on relationship management	Cheung and Rowlinson, 2011
• Joint problem-solving	Cheung and Rowlinson, 2011; Martinsuo and Sariola, 2015
• Information and communication technology platform	Cheung and Rowlinson, 2011; Davies and Mackenzie, 2014; Hietajärvi et al., 2017
• Inter-organisational meetings and working sessions	Davies and Mackenzie, 2014; Aagaard et al., 2015; Hietajärvi et al., 2017
• Co-location	Davies and Mackenzie, 2014; Hietajärvi et al., 2017
• Joint team events and social activities	Davies and Mackenzie, 2014
• Organising integration committees	Davies and Mackenzie, 2014; Hietajärvi et al., 2017
• Technical consultation	Martinsuo and Sariola, 2015
• Product demonstration	Martinsuo and Sariola, 2015
• Pilot project	Martinsuo and Sariola, 2015
• Continuity of key personnel	Hietajärvi et al., 2017
With suppliers in system delivery projects	
Control-oriented practices:	
• Similar coding, agreements, etc.	Martinsuo and Ahola, 2010
• Supplier selection	Martinsuo and Ahola, 2010
• Monitoring of supplier	Martinsuo and Ahola, 2010
Cooperation-oriented practices:	
• Integrative persons	Martinsuo and Ahola, 2010; Ahola et al., 2017
• Informal interaction	Martinsuo and Ahola, 2010
• Regular and *ad hoc* meetings	Martinsuo and Ahola, 2010; Ahola et al., 2017
• Integrated engineering team	Martinsuo and Ahola, 2010
• Training	Martinsuo and Ahola, 2010; Ahola et al., 2017
• Early supplier involvement	Ahola et al., 2017
• Motivating suppliers to innovate	Ahola et al., 2017
• Providing suppliers with physical assets	Ahola et al., 2017
• Co-location	Ahola et al., 2017
• Joint problem-solving	Ahola et al., 2017
• Joint efficiency-seeking	Ahola et al., 2017

2.3.4 Customer integration

The discussion on downstream integration has been mainly concentrated on the firm-customer relationship. Customer integration requires a proactive and collaborative customer relationship (Droge et al., 2004) as it decreases the threat of competitors, improves timely responsiveness, provides customers' insights into the innovation process, and increases customer willingness to pay price premium, and increases customer loyalty (Droge et al., 2004; Piller et al., 2004). Customer integration involves collaborative and information-sharing activities between the firm and its customers that enable the firm to identify expectations and business opportunities and, consequently, respond to customers' needs (Schoenherr and Swink, 2012). Integration with customers can occur at various levels, starting from match-to-order to engineering-to-order where customer co-design of products and/or services (Piller et al., 2004). Customer-oriented project management has also received considerable attention in the project business literature and has become a key element of managing projects (Hellström and Wikström, 2005). Project-based firms in business-to-business markets seek to reduce discontinuities between projects and acquire additional transactions with the same customers (Hadjikhani, 1996). Firms then try to obtain more customer knowledge and utilise previously defined procedures and practices to facilitate interactions between project-based firms and customers (Cova et al., 2002). Therefore, maintaining customer relationships becomes very crucial for project-based firms in times of discontinuity.

Life-cycle solutions have shifted customer relationships from passively responding to customers' needs to building long-term relationship based on trust (Brady et al., 2005; Valtakoski, 2015). Delivering complex solutions usually demands cooperation between project-based firms and customers in developing specifications for projects (Cova and Salle, 2005). Close communication with customers, as an important information source, can help project-based firms to have a better understanding of project needs (Kim and Wilemon, 2002). Advanced ICT systems have also facilitated collecting customer information. However, requirements and opportunities have not been reviewed previously. Customer participation in projects can enhance trust, knowledge-sharing, and collective contributions to project outcomes (Hsu et al., 2011). Earlier studies revealed that customer involvement in the development process of projects increases the odds of meeting customer needs and requirements (Dvir, 2005; Kujala and Ahola, 2005; Raddats and Burton, 2014).

Customer involvement could be varied between external supervision to full participation in project activities (Peled and Dvir, 2012). Furthermore, customer

integration and customer relationship management have the potential to affect project portfolio management, and customers need to be involved in pertinent decisions (Voss, 2012). Customer involvement may alter the organisational design of a project-based firm (Alajoutsijärvi, et al., 2012). While prior literature has not directed attention to specific customer integration practices in different project phases and project contexts, the life-cycle solution literature has stressed the aforementioned proactive and collaborative customer relationship (Raddats and Burton, 2014). Providers and customers jointly plan, execute, and monitor performance (Brady et al., 2005). Services have also been established as the main value added by a solution provider (Liinamaa and Gustafsson, 2010).

The majority of studies have focused on the direct relationship between project-based firms and customers as well as customer integration in the development phase of product and system development projects. However, distributors have a more prominent role in sales channels, especially for manufacturing firms (Ghosh et al., 2004). When firms are or become global both in terms of global customer market and global supply chain, they must be able to deliver projects to their global customers in varying locations. The firms usually face the pressure of globalisation through launching new operation sites in multiple geographic regions (Turkulainen et al., 2015) and/or distributing sales and service organisations globally (Artto and Kujala, 2008). Through utilising distributors, the firms aim to save costs, utilise local expertise, and maximise coverage of global markets (Lin and Chen, 2008). This study acknowledges that relationships with customers are not always direct, but there may be intermediaries – so called third parties – within the project-based firm's customer relationships.

2.4 Synthesis

Existing literature on life-cycle solutions has been clearly titled towards upstream value chains. Such literature confirms that the downstream value chain must be managed (Jalkala et al., 2010), but it does not indicate what needs to be performed by project-based firms in customer-facing phases to assure successful solution business. Actually, these phases have been treated as separate antecedents and descendants to solution development and execution phases. Downstream value chains require specific attention from project-based firms mainly based on two reasons. First, understanding specific needs of customers and delivering value to them as the ultimate goals of solution business (Smyth et al., 2018; Fuentes et al.,

2019) are initiated and delivered in the life-cycle phases occurring in the downstream value chain, i.e., sales and service delivery. Second, in comparison with active actors upstream, i.e. project team and suppliers, internal and external actors downstream do not belong to the temporary core project team and have a more stable position within the permanent organisation. Previous research in supply chain integration has concentrated on the project level and explored integration practices during project execution. Thus, these characteristics and differences call for exploring what integrating services with solution offerings implies in the downstream value chain and how project-based firms integrate internal and external actors not only during a specific project but also at the business level.

Figure 5 depicts the main findings in the literature regarding integration of offerings along with internal and external actors. The more frequent an issue was found in studies, it is shown with a bold font style while the less frequent issues are shown in a regular font style.

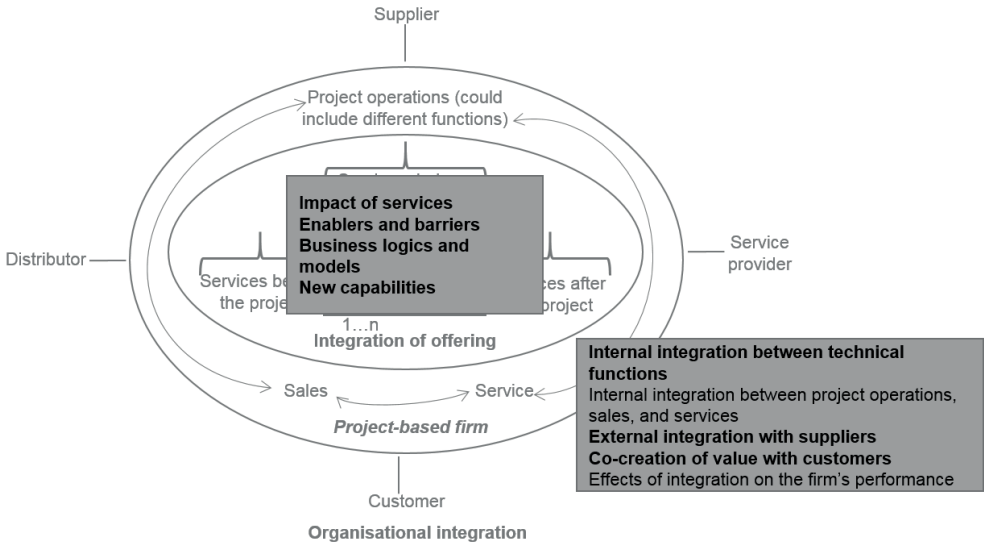


Figure 5. Findings of prior literature on integration of offerings and organisational integration

A significant proportion of the solution business literature concerns the transitions from projects or products to solutions (e.g., Davies, 2004; Brady et al., 2005; Davies et al., 2006), developing solutions (e.g., Brady et al., 2005; Davies et al., 2006), and creating demand (e.g., Bonnemeier et al., 2010) with less of a focus on solution sales and delivery (e.g., Storbacka, 2011), as well as implications of providing life-cycle solutions (e.g., Artto et al., 2015; Ahola et al., 2017). Analysing the previous research shows that the majority of empirical studies are based on the views of senior

managers, directors, and project managers (e.g., Davies and Brady, 2000; Davies, 2004; Brady et al., 2005; Davies et al., 2006; Storbacka, 2011). While services have become a critical part of business for many project-based firms (Kujala et al., 2010), integration of service business with project business has remained a key challenge (Artto et al., 2015). Given the importance of services in life-cycle solutions, there is a necessity to investigate implications of integrating services with solution offerings and exploring challenges and changes that occur in customer-facing phases in the downstream value chain.

Prior literature dealing with life-cycle solutions has recognised cross-functional activities as a major requirement for solution delivery (Storbacka, 2011). These studies have primarily explored integration practices in solution design and execution phases. Though the significant role of services in delivering value-added solutions has been emphasised in the literature, there are minimal investigations examining actors' integration requirements for selling and delivering services as part of the solution offering (e.g., Artto et al., 2015; Ståhle et al., 2019) as is shown in Figure 5. To fill this research gap, this work focuses on interfaces between organisational units involved in selling or delivering services by project-based firms, as illustrated by the solid line in Figure 6. Integration between project operations and sales is not the focus of this study, but project operations was assessed from a sales unit perspective.

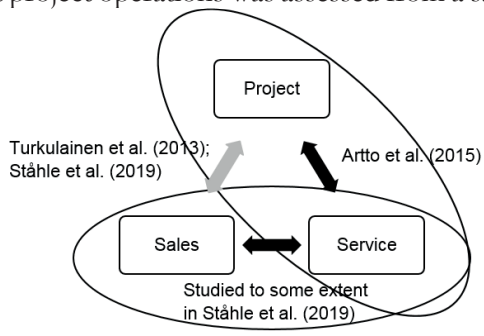


Figure 6. Interfaces between internal actors involved in downstream value chain

The literature review of supply chain integration demonstrates that earlier studies have focused primarily on supplier integration practices and contractor integration practices (e.g., Aagaard et al., 2015; Ahola et al., 2017; Cheung and Rowlinson, 2011; Davies and Mackenzie, 2014; Errasti et al., 2007; Hietajärvi et al., 2017; Martinsuo and Ahola, 2010; Martinsuo and Sariola, 2015). Scholars have broadly assessed various challenges, benefits, and integration mechanisms (e.g., Ahola et al., 2017; Martinsuo and Ahola, 2010). The focus of integration literature on supplier integration could explain product-centric integration practices. While integration

with customers has been stressed in solution literature (Brady et al., 2005), studies that provide empirical evidence on customer integration practices are also a rarity (e.g., Liinamaa and Gustafsson, 2010). Figure 7 illustrates the relationship between external actors in the downstream value chain of project-based firms. There are no articles on how external actors, such as distributors, experience adding services to a firm's solution offerings in practice. The upstream value chain position of the firm affect the required customer relationships to enable integration of services with the solution offerings (Jovanovic et al., 2016). To fill this research gap, the work herein concentrates on project-based firm-distributor relationships, as illustrated by the solid line in Figure 7.

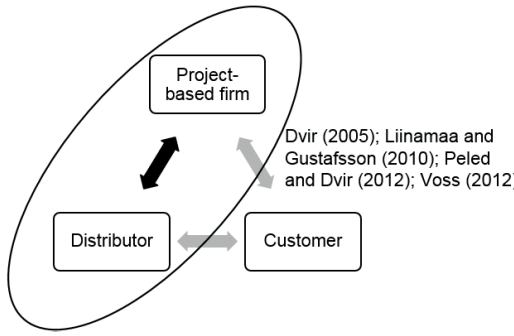


Figure 7. Interfaces between external actors involved in the downstream value chain

3 METHODOLOGY

3.1 Nature of the research

All research is guided by a research paradigm, which is the required foundation for making sense of the findings of a study (Biedenbach and Müller, 2011). A paradigm directs the research by explicating the nature of reality (i.e., ontology), the nature of knowledge (i.e., epistemology), and the procedure to acquire knowledge (i.e., methodology) (Guba and Lincoln, 1994). This research is not entering to the debate of realism and anti-realism; instead, it takes the perspective of pragmatism (Morgan, 2007). Pragmatism accepts the existence of reality but a reality that is based on actions and not ready-made things (James, 1909 in Lalonde et al., 2010). Thus, actions are the core of the pragmatism paradigm, and the pragmatist approach proposes "praxis", a form of context-dependent and situational action, as the centre of research and theory making (Cicmil et al., 2006).

Accordingly, the present study builds on "project actuality" and "project-as-practice" research (Cicmil et al., 2006; Blomquist et al., 2010) as well as the assumption that actions, decisions, and behaviours are continuously made through control and collaborative interaction in real time (Cicmil et al., 2006). Project management is not only a descriptive scientific discipline but both a scientific and professional discipline, which makes it different from the social sciences (Lalonde et al., 2010). The research-based theory and techniques can be effective for certain aspects of professional practices, but, in complex and ever-changing environments, such as project situations, the practitioners can describe their experiences, trial and error, and intuition (Blomquist et al., 2010).

Thus, through pragmatist research, the researcher of the present study wants to study the lived experience of practitioners (Cicmil et al., 2006). This research is practice-oriented and the focus is on the actors and their activities rather than the models and their applications (Blomquist et al., 2010). The present study aims to theorise integration practices through the cooperative inquiry of the researcher and practitioners concerning the practitioners' experiences and actions (Cicmil et al., 2006). The "truth" or "reality" in this research is not a universal truth or general knowledge but an "accessible truth" that depends on collective action (Hatchuel,

2005). Pragmatic epistemology involves reflective practitioners and pragmatic researchers (Calori, 2002). In this study, first, the knowledge about the phenomena was built upon multiple voices of practitioners reflecting upon their experiences ("knowledge of acquaintance"). Further, through a systematic analysis, the researcher "eliminates the subjective and contextual contingencies of experience and extracts the principles that lie behind the knowledge of acquaintance" (Spender, 1996) which results in "knowledge about".

Pragmatism fosters methodological choices that are active and participatory (Lalonde et al., 2010). From a pragmatism standpoint, the choice of qualitative or quantitative research methods is not fixed in the epistemology but based on the research questions (Biedenbach and Müller, 2011), which should have both scientific and practical relevance (Lalonde et al., 2010). The research questions concerning how project-based firms integrate services with solution offerings and integrate internal and external actors required an explorative approach that fostered a qualitative case study. While the present research does not follow action research in terms of an active and participatory methodology, to create pragmatic and contextualised knowledge, the researcher used an active interview instead of a structured or survey interview that allowed the practitioners to reflect and interprets their experiences (Cicmil et al., 2006). During the interviews, the practitioners reflected upon their experiences concerning the way they coped with the changes and challenges raised from the integration of services with solution offerings, the way the practitioners participated in the solution sales and delivery processes, and the kind of tools, techniques, knowledge, and skills that they used and developed during the experience.

3.2 Research strategy

The present study can be categorised as a compilation of qualitative case studies of project-based firms, based primarily on interview data. In line with the pragmatist paradigm and the dominant methodology used in prior literature concerning integration in project-based firms (Martinsuo and Ahola, 2010; Davies and Mackenzie, 2014; Aagaard et al., 2015; Artto et al., 2015; Ahola et al., 2017; Hietajärvi et al., 2017), this research also uses a qualitative approach. The main reason for choosing a qualitative approach emanates from the research objective and research questions, which have an explorative character (Corbin and Strauss, 2008; Yin, 2009). Moreover, to study how project-based firms integrate services with solution

offerings and to explore integration practices within project-based firms and at customer boundaries, it was important to listen to practitioners' reflections on their own experiences and actions (Cicmil et al., 2006).

A case study methodology was selected for this explorative and qualitative study given that case studies have been the preferred methodology for research in the project business and solution domains (e.g., Artto et al., 2015; Wikström et al., 2009). It has been used widely because it permits researchers to investigate a complex situation and the relationship between the contextual conditions and the main phenomenon (Meredith, 1998; Yin, 1994:13). Eisenhardt (1989:534) describes the case study as "a research strategy which focuses on understanding the dynamics within single settings". This also fits well with the nature of the present work, which explores the dynamics of integration between different actors of project-based firms. Using case studies in the present dissertation allowed the researcher to go beyond what type of services are provided in project-based firms and what actors are involved in solution sales and delivery, enabling understanding of how project-based firms integrate offerings and actors in the downstream value chain and, to some extent, why they select a set of practices (Meredith, 1998).

The unit of observation for this study was individuals – managers and service staff working in project-based firms. With the exception of Article I, which analysed different approaches using customer information and data at the firm level, *the level of analysis* for all other articles was a group or unit, i.e., where micro-level actions take place. The researcher analysed the actions of a group of individuals in the service unit (Article II), in the distribution management team (Article III), and in the sales unit (Article IV). The *unit of analysis* of the research was generally service integration practices. Each article had a somewhat different unit of analysis, and, thus, they focused on different perspectives of service integration in the downstream value chain. Article I focused on different approaches using customer information and data from RMS. Further, Articles II and IV looked at service integration practices through an intra-organisational perspective during solution sales and delivery. Article III analysed integration practices with distributors through an inter-organisational perspective. Table 7 provides a summary of the focus of the data analysis in the original articles.

The case studies were conducted as four separate case studies, constituting a combination of multiple, comparative, and single case studies. The research design has followed a sequential approach— in the first phase, the multiple case study was conducted. The results of the first phase determined the need to explore service units

in project-based firms and thus set the research direction for the second phase. The comparative case study of the second phase was concentrated on service units, revealing the role of intermediaries in the downstream value chain of one project-based firm. The single case study from the third phase assessed this phenomenon and further highlighted the need for further research on internal integration practices that enable integration of services in the solution offerings of project-based firms. These findings resulted in comparative case studies during the fourth phase. Combining multiple, comparative, and single case studies could be a form of methodological triangulation; Bryman (2001) calls this "the use of varieties of the same method to investigate a research issue". This thesis explores an area of research that consists of several sub-areas that need to be treated differently. For example, while comparative case studies were strong in revealing differences among cases, a single case study was the best choice for gaining more depth to generate new knowledge on a certain phenomenon. This research strategy benefitted from positive aspects of a case methodology and mitigated the negative aspects.

Table 7. Data analysis in the original articles

Article	Unit of observation	Level of analysis	Unit of analysis	Focus of data analysis
Article I	Individual	Firm level	The company's approach to using customer information and RMS	Identification of different approaches using customer information and data from RMS
Article II	Individual	Service unit level	Resource allocation practices	Identification of the main resource allocation challenges and practices in integrating service and project activities
Article III	Individual	Distribution management team level	Integration mechanisms	Identification of the main capabilities required of distributors and integration mechanisms at the business and project levels
Article IV	Individual	Sales organisation level	Sales practices	Identification of different needs that salespeople face when integrating services into project offerings and different practices for managing service integration into solution offerings

3.3 Research context

The research was conducted in Finland with three core case companies that are project-based firms operating in the engineering and technology industry. Finland's technology industry was one of the strengths of the Finnish economy and exports. The machinery and equipment sector, as one of the key sectors in the technology industry, consists of various large and small-medium-sized firms in the fields of construction equipment and building material machinery, mining machinery, robotics and automation, power systems, industrial plant manufacturing, and so on. Some of the significant trends in the market that affect Finnish firms in the technology industry are internationalization, increasing importance of services, and for a rise in customer-specific system solutions and integrated services (The Federation of Finnish Technology Industries, 2015). These changes in the environment lead to different opportunities as well as challenges, among them integration of services in solution offerings and integration of different actors to support solution business as in the focus of this thesis.

The case firms were selected based on a theoretical sampling approach (Barrartt et al., 2011) as the purpose of the study was not to develop a generally applicable contribution but to provide a deep understanding of how service integration occurs in the downstream value chain of project-based firms (Eisenhardt, 1989). All case firms participated in a research program that allowed the researcher to choose the appropriate target firms based on the researcher's and the firms' mutual interest in the studied phenomena. The first sub-study covered the manufacturing firms enrolled in a specific research project of the program and guided the design of the second study. The selection of the case firms for each later study was decided based on the findings or observations of the preceding case studies. The main reason for having chosen these cases is that they are project-based firms that offer a variety of products, complex systems, and services. They operate in the engineering and technology sector, and their industrial offerings are usually tailored specifically for each customer and sold to other industrial firms globally. As leading firms in their industry, they make the cases useful for reflecting on the findings for benchmarking purposes (Barratt et al., 2011). The service business has become an important part of their portfolios and all firms have specific service units that deliver services to their customers. Table 8 features basic information about the case companies. For anonymity purposes, the firms are presented with fictional names and codes. Table 8 also lists which cases were reported in which articles by highlighting the related cell with a grey colour and introducing the given name for each article. For example,

Company Alfa was called Company F in Article I, Company B in Article II, and Company A in Article IV. The case studies do not cover the entirety of firms. The studied organisational units, such as the sales unit, service unit, and distributor management team represent efforts, changes, and challenges in combining projects and services in the case companies.

Table 8. Background information on the companies, their links with the articles, and their specific labelling in each article

Case companies	Industry	Customers	Key figures	Articles			
				I	II	III	IV
Core cases:							
Alfa	Equipment, system, and service provider in the fields of electrification, robotics, automation, and power	Utilities industry transport & infrastructure	Employees > 5000 Net sales > €2,000 million	F	B		A
Beta	Equipment and service provider in certain industries	Mining, aggregates, recycling, and process industries	Employees > 12000 Net sales > €2,000 million	E	A	Case company	
Gamma	System, software, and service providers in the fields of manufacturing management and automation	Manufacturing industry	Employees < 500 Net sales < €100 million	C			B
Additional cases:							
Delta	Equipment and service provider in the field of wood processing	The wood products industry	Employees < 1000 Net sales < € 200 million	A			
Epsilon	Process technologies, automation, and service provider for certain industries	Pulp, paper, and energy industries	Employees > 10000 Net sales > €3000 million	B			
Zeta	System and service providers in the waste-to energy industry	Power and process industry	Employees < 200 Net sales < €100 million	D			

3.4 Research methods

Table 9 presents a summary of research methods in each article. A more detailed explanation of the research methods of articles is provided in the original articles.

Table 9. Research methods in the articles

Article	Research method	Data collection
Article I	• Qualitative research approach • Multiple case study	• Semi-structured interview • Six firms • 16 respondents • Mainly technology, product, and service managers
Article II	• Qualitative research approach • Comparative case study	• Semi-structured interview • Two firms • 17 respondents • Mainly service managers and service staff
Article III	• Qualitative research approach • Single case study	• Semi-structured interview • One firm • 11 respondents • Mainly distribution directors
Article IV	• Qualitative research approach • Comparative case study	• Semi-structured interview • Two firms • 20 respondents • Mainly sales managers

The multiple case study of six firms (published in Article I) is used to not limiting the findings to one specific firm and allowing the findings to be replicated among different cases (Eisenhardt, 1989 and Yin, 1994). The limited number of cases allowed the researcher to go deeper for exploration and provide a rich description. The study investigates the use of advanced ICT systems, such as RMS, to foster service business and enhance customer relationships. This study uncovered findings regarding cooperation between service, sales, and project units that need to be enriched by further study.

A multiple case study approach was criticised by certain scholars mainly because of not allowing the researcher to deeply understand and describe the context of the social dynamics of the case (Dyer and Wilkins, 1991). In order to solicit more depth, Article II is based on a comparative case study of service units at two case companies revisited after the first study. The case was selected to be informative concerning resource allocation in dynamic environments delivering both projects and services. As the number of cases that can be studied in any research project is limited, it is not preferable to choose cases randomly (Eisenhardt, 1989), but rather is important to

opt for cases where relevant data could be gathered. Therefore, two companies were sought in a similar kind of context that would represent diverse resource allocation practices. The study elaborates the challenges in integration of project and service work and reveals two resource allocation approaches to manage work in dynamic environments.

During the research process in one of the cases reported in Article II, it was stated that the firm also utilised a network of distributors to sell and deliver projects and services. Thus, In Article III, a single case study in the project-based firm contributed to a deeper understanding of the role of external actors in the downstream value chain. As the project business literature has not evaluated the relationship with distributors, a single case study was chosen to examine this topic and determine relevant issues within an empirical setting. The single case study was applied to evaluate a representative case (Yin, 2009: 48) using purposeful sampling (Silverman, 2010: 141). The representative case was supposed to be a firm with distributors that were not only resellers but also collaborated with the project-based firm while executing projects. The case firm was selected based on its engineer-to-order manufacturing character and extended use of distribution channels to supply its customers with systems and after-sales services, as well as the firm's interest in developing distributors and distributor management.

In Article IV, selling solutions by internal actors of project-based firms were explored through a comparative case study of two firms, specifically the actuality of their sales practices. Purposeful sampling (Silverman, 2010: 141) was employed to select two firms. The firms needed to be recognised as industrial project and service providers in their markets. They were expected to be involved in delivering solution offerings. It was also important to select two firms that were sufficiently similar but also different with respect to their size, industry, and offerings. The number of firms was limited to two in order to collect rich data to understand the solution sales work in practice.

3.5 Data collection

Interviews were the main source for data gathering in this thesis. In-depth interviews were employed to gather rich and detailed data about experiences, perceptions, and opinions surrounding providing life-cycle solutions, challenges, changes in the organisations, and relationships and collaboration between different units (Gioia et al., 2012). The selected interviewees were actively involved in selling and delivering

solutions and had central roles in relationships at different interfaces. The interviewees were selected by consulting with contact people in each company to determine the most knowledgeable people in the organisations concerning the studied phenomena. Thus, the interviewees were experienced managers and staff who were able to provide detailed knowledge about their experiences and real-world practices in their daily work.

The interviews were conducted as semi-structured interviews to allow interviewees to express their opinions and elaborate upon those issues that were most important for them (Yin, 2009). For each phase of the research, a thematic outline was designed based on the research questions, pre-study, and initial meeting with contact persons. Through a thorough interview outline without any leading-the-witness questions, the interviewees were permitted to talk about their own experiences and opinions freely (Gioia et al., 2012). As the research progressed, the interview outlines were revised to cover the emerging questions relevant to the research task (Gioia et al., 2012). All interviews were recorded and transcribed. Table 10 summarises the interview data for each article.

The research followed certain principles to ensure that ethical concerns were addressed while conducting and publishing the research. The project contract between the university and the companies governed confidentiality in all steps of the research. All companies in this research voluntarily participated (Bryman and Bell, 2007:135). The contact persons in the companies were informed about the objectives and approach of the research and were also consulted for their expectations concerning the research and presentation of findings. Furthermore, the potential interviewees received an outline of the research intent and rough interview themes beforehand and had the right to participate or withdraw from the study (Saunders et al., 2012:179). The open-ended questions of the interviews were discussed with the contact persons to avoid any offensive or unacceptable questions. The privacy and anonymity of the companies and informants were ensured through removing all information that could possibly reveal their identities (Pearson et al., 2015). Additionally, the findings of the study were submitted to the contact persons for review to ensure that the confidentiality issues were considered (Lundin, 2011) and to offer a possibility to correct any errors concerning facts or interpretations. Data storage and handling followed the university procedure. Following the publication policy of the project contract, all articles were submitted through the project publication procedure and received a formal permission for publication.

Table 10. Interview data

Article	Main themes	Number of interviewees	Additional sources
Article I	The importance of service business, service design and delivery process, channels for identifying customers' needs and expectations, the role of RMS in the service business, and possibilities for utilising remote data	16 CEO (1) Technology manager/director (2) Research and development manager (1) Service manager/director (8) Product manager (4)	External company information material; Documents of the service processes, development plans.
Article II	Structure of the organisation, the types of project and service activities conducted, work environment, resource allocation process, key participants in decision-making and links to other units	17 Service managers (7) Service staff (8) Technology manager (1) Product manager (1)	Resource planning and monitoring systems
Article III	The role of the distributors, organisational structure for the distribution channel, distributors' required capabilities, relationship with distributors, integration with distributors in different phases of system delivery, and general issues in the firm–distributor relationship	11 Head of distribution (1) Distribution director (8) Technical support director (1) Training manager (1)	Distributors' evaluation process; Training programs; Sample of the training material;
Article IV	Experiences with current services, perspectives on selling services as part of the solution offering, process of selling projects and services, communication and cooperation between sales and service units, practices for integration of sales efforts, and competencies required for sales forces to sell solutions	20 System sales managers (7) Systems and service sales managers (2) Service sales manager (1) Key account managers (4) Service managers (2) Service-sales specialists (2) Proposal manager (1) Training specialist (1)	

3.6 Data analysis

In all articles within this thesis, the main data analysis approach was inductive as there was not a specific preliminary framework in the previous literature. However, following Eisenhardt's (1989) suggestion, data analysis was not conducted as a "clean slate" approach. Existing theories play an important role in case study research, and the data analysis phase was conducted according to some rationale and expectations (Gioia et al., 2012; Ketokivi and Choi, 2014). The pre-step of data analysis occurred

during data collection, and various tentative codes and categories emerged during interviewing. The initial analysis at this step was merely based on the interviewees' terms and no specific category labels (Gioia et al., 2012). After completing the data collection, the data analysis followed a systematic approach. As presented in Figure 8, the data analysis for all four studies was conducted in three phases. In practice, each article was developed through an independent data analysis presented in the original articles.

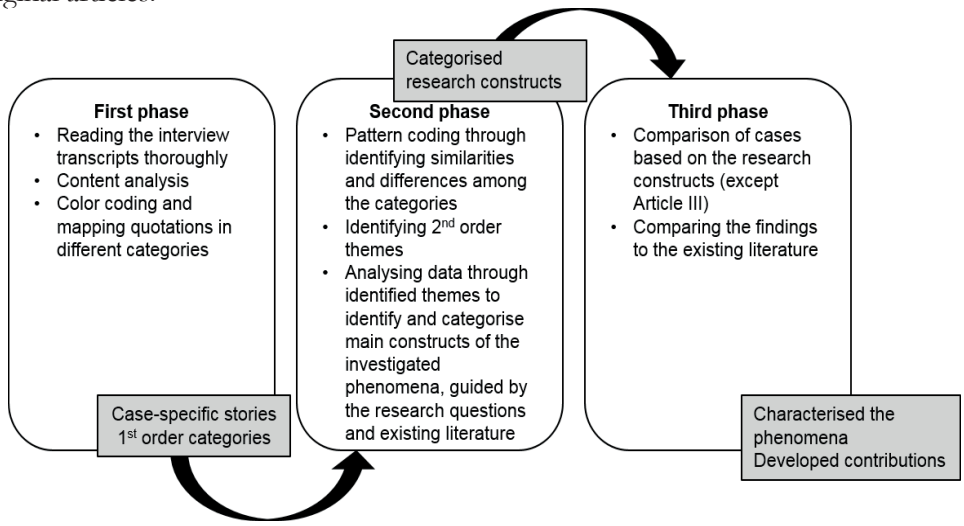


Figure 8. Description of the data analysis process

The purpose of the first phase of the analysis was to develop case-specific stories, which was conducted through within-case analysis that indicated the emerging patterns of each case (Barratt et al., 2011). First, the data was content-analysed by reading the transcripts thoroughly. Then, important quotations were identified through colour coding and mapped in different first order categories. Figure 9 illustrates an example of defining the first order categories in Article II.

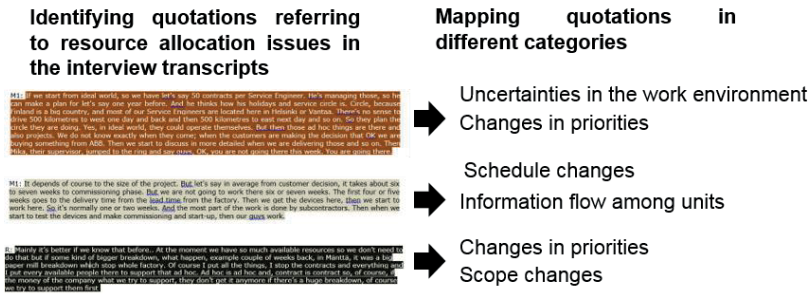


Figure 9. Illustration of identifying first order categories in Article II

The purpose of the second phase was to develop research constructs that characterised the investigated phenomena. Pattern coding was conducted through identifying the similarities and differences among the categories. The analysis at this phase was iterative, and more detailed second order themes were generated. Through the further analysis of data using these identified themes and the findings of existing literature, the investigated phenomenon was categorized through the research constructs. For example, in Article I, the focus of analysis was on the various approaches for using customer information as well as experiences using data from RMS. In Article II, the identified resource allocation challenges and practices were labelled as resource allocation issues and managerial practices. The case-specific stories characterised resource allocation approaches in each case as 'hybrid' or 'bottom-up'. In Article III, the identified integration mechanisms were categorised as business- or project-level actions and were further coded into cooperation, control, and development-oriented mechanisms according to the literature review and interview data in terms of the types of integration mechanisms. In Article IV, different challenges that salespeople face in integrating services into solution offerings were grouped inductively into four groups of emerging needs in sales work. Furthermore, by referencing the literature, the service integration practices were grouped into control-oriented, cooperation-oriented, and development-oriented practices, and, based on further analysis, they were divided into project-level and business-level practices. Figure 10 illustrates an example of how the categories turned into the research constructs in Article III.

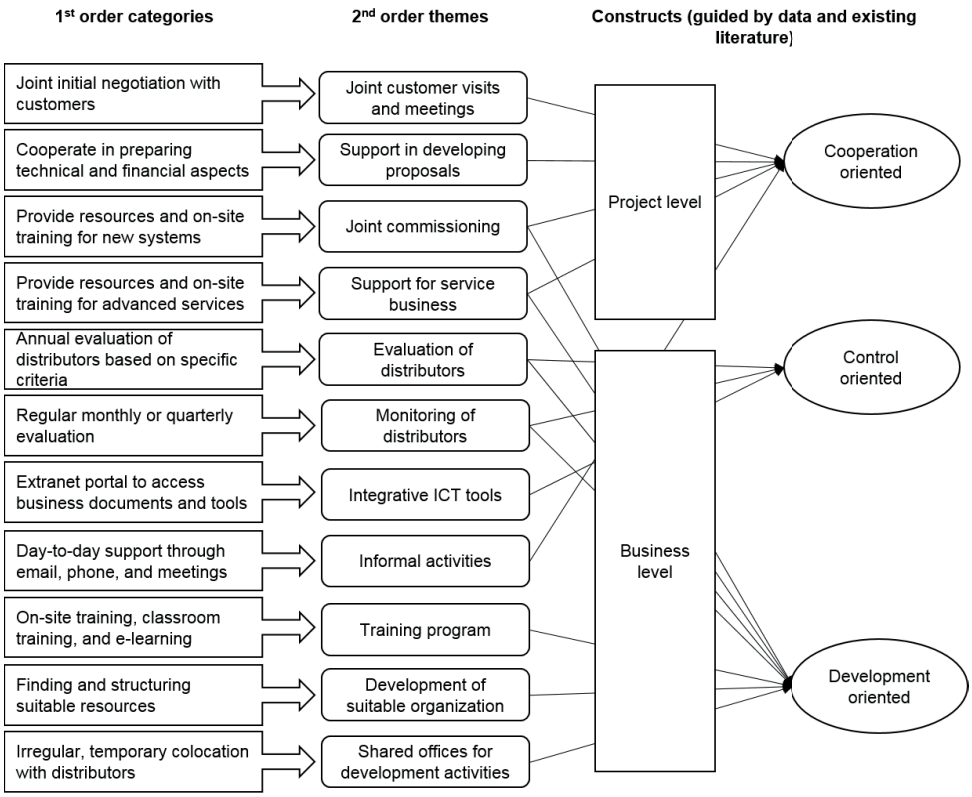


Figure 10. Illustration of the second cycle analysis in Article III (following the logic of Gioia et al. [2012]).

The purpose of the third phase was to explore the investigated phenomena and to develop contributions. In Articles I, II, and IV, cross-case analyses were performed to identify similarities and differences between the case companies. The basis for the case comparison was the identified constructs during the second phase of the analysis. The focus of the cross-case analysis was to identify similar patterns between cases. However, when the differences between the cases were revealed, the situations that contributed to the difference were analysed further and clarified (Barratt et al., 2011). Finally, to make the appropriate connection between theory and empirical analysis, instead of only reasoning from data to conclusions, the findings were contrasted with previous literature to highlight the key phenomena and to develop contributions (Ketokivi and Choi, 2014). Table 11 illustrates one example of cross-case analysis in Article II. For a single case study (Article III), excerpts from the interviews were utilised to highlight the viewpoints of interviewees, to provide examples, and to increase transparency. For comparative case studies (Articles I, II,

and IV), multiple tables were used aside from the quotation from key informants to make the data self-evident and to summarize the empirical evidence within the case studies (Barratt et al., 2011).

Table 11. Illustration of cross-case analysis in Article II (Adopted from Article II)

	Hybrid approach (Case A)	Bottom-up approach (Case B)
Where?	Medium complexity in terms of structural and emergent complexities (Maylor and Turner, 2017)	High complexity in terms of structural and emergent complexities (Maylor and Turner, 2017)
What?	Organising resources while increasing responsiveness	Increasing responsiveness
Why?	Ensuring the right prioritisation of activities in a dynamic environment	Reacting fast to the changes in time, scope and type of activities Adapting to uncertainties in the environment

The post-step for data analysis was to ensure the reliability of data analysis. To mitigate the risk of adopting the interviewees' view and losing a higher-level perspective in data analysis, the findings were discussed with a co-author with an outside perspective to ensure the rationalisation of interpretations (Gioia et al., 2012). To synthesise the findings of the original articles, cross-article analyses were performed. First, the challenges of offering integration were further analysed to find the required interactions and integration needs for business units' interfaces during solution sales and delivery (Tables 20 and 21).

Furthermore, integration challenges were inductively divided into offering-, people-, and process-related challenges. The identified integration practices were analysed to determine the type of practices more suitable for responding to each specific group of challenges (Table 24). Then, through further analysis of integration practices based on the existing literature on control mechanisms (Cardinal, 2001) and organisational collaboration (Gulati et al., 2012), control-oriented practices were further divided into input, process, and output control, and coordinate practices were distinguished from cooperative practices.

Next, analysing the integration practices at different interfaces revealed that some of these practices were planned, and others emerged based on instantaneous needs. Therefore, the integration practices were further divided into planned and emergent practices (e.g., Bamford and Forrester, 2003). The categorisation of integration practices was cross-tabulated to propose what type of integration practices and at which level they are more relevant in different situations. Table 12 illustrates the data analysis process for drawing conclusions.

Table 12. The analysis process for drawing conclusions

Research question	Objective	Method of data analysis and data display
RQ1. How do project-based firms integrate services with projects in the downstream value chain?	Data display Conclusion drawing	• Content analysis to characterise the implications of integrating services with solution offerings. • Building a table of challenges, interactions among business units, and integration needs. • Pattern coding and categorising challenges into offering-related, people-related, and process-related challenges.
RQ2: How do project-based firms integrate internal and external actors in the downstream value chain?	Data display Proposition drawing	• Clustering integration practices through identified challenge categories. • Discussing the findings with previous literature and drawing propositions on the relationship between the integration of the offering and actors. • Categorising the integration practices to project-level and business-level practices; Discussing the findings with previous literature and drawing propositions concerning the changes in the level of integration practices over the life-cycle of project. • Categorising control- and cooperation-oriented practices to different forms • Discussing the findings with previous literature and drawing propositions concerning the use of different types of integration practices at different interfaces and levels. • Categorising the integration practices into planned and emergent practices. • Discussing the findings with previous literature and drawing propositions concerning the use of different types of integration practices at different interfaces.

4 FINDINGS

4.1 Integrating advanced technology into service business and customer relationship processes

Article I focused on the role of RMS in the firm-customer relationships through improving service business and along with the amount and quality of customer data. As RMS and advanced ICT systems are adopted, they can complement other customer information collection channels, thereby enhancing the efficiency of services through improved knowledge access, removal of physical distances, and better validity and quality of data. This study underscores possible broader applications of RMS in an engineering firm's business, in customer relationship management, marketing, product and service development, and the customisation process. A qualitative multiple-case study was conducted with six engineering firms — Company Alfa, Betta, Gamma, Delta, Epsilon, Zeta.

The findings highlight the role of RMS in enabling engineering firms to collect data from customers to augment the firms' limited knowledge of their customers. The study hence demonstrates the business value of using RMS in industrial services, and the necessity of capturing such business value through advanced IT technologies.

4.1.1 Business value in using data collected through RMS

An important concern in using RMS is how manufacturers can utilise the substantial amount of data collected through it. Manufacturers must provide some value-added solutions for their customers and own organisations to be able to create business through RMS. Table 13 outlines the core issues through which RMS were identified as a source of business value according to the interviewees' experiences.

Table 13. Means to create value from RMS in manufacturing firm's business processes (adopted from Article I)

Value-creating business process	Role of RMS	Benefit for business value
Customer relationship management	Data collection on equipment, its use, and different user profiles	Enables timely or preventive maintenance and early identification or even foresight of problems, thereby can reduce costs and equipment downtime
Marketing	Data collection on equipment performance	Enables calculation of financial effects of problems in equipment use, permits benefits of the remote services, and calculating the value proposition / business case for the customer
Product development and customisation	Continuous monitoring of equipment status, use, problems, and performance	Enables increased understanding of the customers' operations and performance, design of better customised solutions, and targeting of the right solutions to the right customers
Performance improvement and after-sales service	Evaluating equipment use and comparing to specification	Enables offering solutions for performance improvement and avoiding faults and breakdowns
New business development	Organising the data and summarising the level of customer segment or area	Enables creation and selling of reference data; enables customers to compare with "best in class" or reference market; enables offering targeted new services depending on equipment use patterns

4.1.2 Various approaches to collect customer information

Manufacturers employ different means to identify customers' needs and expectations. Close customer relationships and deep knowledge of their industry and technology have been the main approaches to using customer information. Feedback from salespeople and customer relationship management systems are among the possible channels for some companies to identify customers' expectations. The main challenge of these relationship-based approaches is that they are usually effective for customers who already have an established, long-term relationship with the firms and trust in them. However, occasionally, it does not offer a real picture of the customers' expectations. Holding customer focus groups and workshops also serves as opportunities to discuss different topics directly with certain customers, especially surrounding their needs and expectations. However, these approaches are more effective for analysing specific issues with those customers who already have more experience, knowledge, and understanding of the topics under discussion.

Inspections of the customer's site are considered an effective technique for observing the customer's business and identifying potential needs and opportunities.

According to the interviewees, RMS reduced the need for physical inspections at the customers' sites, provided continuous or more frequent connections with the equipment, and, consequently, resulted in a substantial amount of data with less cost than if the data were collected manually. Most customers play a limited and passive role in the development of new solutions based on the data. With the exception of a select group of more advanced customers, the vast majority are not active and only benefit from developed solutions if manufacturing firms first envision customer needs and offer them proactively. This is mainly because of the complexity of the products and solutions. Thus, the latent needs of customers are not necessarily expressed by customers through relationship-based approaches.

4.1.3 Contribution of Article I

The findings have indicated that basic RMS-enabled services, such as assessing spare parts needs and calculating machine hours, are insufficient; firms should utilise the potential capabilities of RMS in their business processes more broadly to increase customer knowledge and knowledge of product use, and convert the substantial amount of collected data into business value. This study contributes to previous research in service business regarding the role of customers and customer information within service development. Manufacturing firms must strike a balance between automation resulting from advanced technologies and the quality and value of services for customers (Kowalkowski and Brehmer, 2008). Advanced technologies should be increasingly integrated into information-collection processes of manufacturing firms to find the unexpressed needs of customers, decrease data collection costs, and increase the validity and quality of the collected data.

4.2 Integrating project and service activities within service units: Challenges and practices of resource allocation

The study in Article II concentrated on service units that operate in a dynamic environment where project-based firms use human resources for both project and service activities. A qualitative comparative case study was conducted in the service units of Company Alfa and Beta. This study recognises that a constantly changing

environment requires a completely different, more dynamic logic for resource allocation compared to the previously dominant hierarchical model of resource planning used both in projects and within project portfolios.

4.2.1 Challenges for service units in adding project activities to service activities

The service staff are involved in different projects, from simple service projects relying mainly on service staff to more complex projects that draw upon versatile resources from different departments within the firm. Table 14 shows the main activities involving service staff and their various characteristics, particularly in relation to uncertainty. While service units of both companies engage in all types of activities, the share of project-related activities and service contracts is higher for Company Beta. Meanwhile, Company Alfa's service staff face more *ad hoc* requests and provide more urgent repair and maintenance services.

Table 14. Different types of activities in service units and their uncertainty characteristics (adopted from Article II)

Type	Activities	Characteristics
Core project-related activities	Start-up and commissioning, product development	High uncertainty in time Different units' resources
Service projects	Upgrade, modernisation, expansion	Medium uncertainty in time and scope Mainly service unit's resources
Service contracts	Preventive maintenance	Low uncertainty in time and scope Long-term plan Only service unit's resources
Ad hoc services	Spare parts and tools delivery, repair	High uncertainty in time and scope Major emergency Only service unit's resources

While service units attempt to deploy their human resources efficiently among both project and service activities, they have to change their schedules and resource-allocation decisions frequently. As presented in Table 13, two types of activities feature additional uncertainties: core project-related activities and *ad hoc* services. These uncertainties usually originate from two separate sources in the service unit environment: the project management unit and customers.

Activities that are related to the core projects of companies are reliant upon project management units. Start-up and commissioning comprise the last phase of the companies' core project delivery and can last from one week to six months

depending on the complexity of equipment delivery. The timing of these activities depends completely on the previous phases of the project, which are carried out by other departments. Start-up and commissioning are usually defined in the project plan as comprising one activity. Meanwhile, the service unit plans and manages the details of start-up and commissioning activities. In addition to these core projects, service staff are occasionally allocated to other project activities, such as new product development. Their role is usually restricted to the final phase of development projects – they might monitor pilot projects and provide feedback for the product management unit.

The resource allocation plan may change owing to delays in previous phases of a project as a consequence of activities in other departments. As service staff are involved in the final phases of core projects, their schedules and resource management decisions are affected by these previous phases, which creates uncertainties for the timing of project-related activities. Service units therefore do not always have resources available to allocate to the project at the required time. This issue becomes more important when the core project relates to the whole production process. In this case, service staff might be involved at various stages of the project execution phase. Thus, it is very difficult to determine what the time frame is.

Second, such *ad hoc* services as delivering spare parts along with repair and maintenance service form a significant part of the work of service staff. The customers are usually in crisis when they ask for help from these companies, and service units must respond to their unplanned requests as soon as possible. The scope of these activities is usually uncertain, and service staff must estimate the amount of effort required after visiting the equipment or production line. Those interviewed highlighted the fact that resources allocated during the planning phase do not always represent the actual service staff that carry out activities during the execution phase because of *ad hoc* repair and maintenance activity at customers' locations. Solving urgent issues is the highest priority for service staff and can impact resource allocation plans.

4.2.2 Resource allocation practices

Besides similar issues that service units face in allocating resources, the study revealed two rather different approaches in resource allocation. Table 15 presents an overview of these practices in the two case companies.

Hybrid resource allocation process: In Company Beta, besides service managers and service staff, a planner exercised a critical role in allocating activities within the service unit. While the service staff played a major part in managing their workload, they were required to communicate with the planner regarding any new activities or changes in their plans. Based on uncertainty in the environment, prioritising activities became an important practice in the service unit. The planner, with the help of the manager, schedules (and reschedules) project and service activities based on their priorities at the time decisions are made. Uncertainties regarding the schedule of the start-up and commissioning phase of projects may cause difficulties in developing long-term plans and managing resource allocation. Project managers would communicate with service managers about project-related services, project plans, and resource requirements. To acquire an up-to-date schedule, the planner or the service manager continuously requires information from the project management team surrounding project progress. The communication and information flow between the project team and service unit, and this would help the planner release resources, allocating them to other important activities or finding available resources whenever a project needed them.

Table 15. Overview of resource allocation practices in the two case companies (adopted from Article II)

	Company Beta: Hybrid resource allocation process	**Company Alfa: Bottom-up resource allocation process**
Resource allocation practice	The resource planner plans resource allocation based on the availability and technical skills of the staff. The service managers and service staff plan the workload and negotiate solving issues	The service staff plans their resource allocation. The service managers support them in critical situations
Authority to prioritise activities	The planner sets the priorities in cooperation with the service manager	The service staff set the priorities of their own tasks. The service managers supports them in critical situations
Cross-functional communication	The service manager or planner receives updates about the progress of core projects from the project team. The service manager has a continuous relationship with the sales unit regarding upcoming projects and contracts	The service manager receives updates about the progress of core projects from the project team, customers, or related internal or external contractors. The service managers and service staff are involved in sales activities and support the sales unit
Categorising resources in the resource pool	There are specific resources for start-up and commissioning as well as *ad hoc* repair and maintenance	There is no specific division of resources based on the type of activity

Bottom-up resource allocation: The service managers give more authority to the service staff and empower them to make most resource allocation decisions on their own. Interviews at Company Alfa highlighted that owing to a high number of unplanned customer requests, the service unit shortened the decision-making process to respond more rapidly to customer requests. Service engineers were required to prioritise their tasks, create their own timetables, communicate with customers and other units, and update their plans frequently. Regarding start-up and commissioning, service managers were responsible for choosing those most suitable for projects. They made these decisions based on their skills and experience, and then checked the availability of these resources during the estimated timetable. Receiving up-to-date information about project progress played a decisive part in managing resource allocation. Service managers continuously received information about project progress from the project management team, customers or related internal or external contactors. Moreover, more experienced staff worked closely with the sales unit and received information about upcoming projects and contracts. This practice helped members of the service unit to gain a more reliable picture of their future workload.

4.2.3 Contribution of Article II

This study analysed service units in engineering firms as a dynamic context where both project and service activities are carried out, and the changing needs of customers that must be taken into account. In the context of service-centric projects, previous research has pointed out the very different degrees of autonomy (including resource autonomy) across different types of projects and contexts (Martinsuo and Lehtonen, 2009). One of the key requirements for human resources in a dynamic environment is to respond quickly to changes. Different project-based firms have specific critical traits that determines suitable managerial approaches (Dvir et al., 1998; Shenhar, 2001). The study showed that based on the level of uncertainty in the environment and activities, service units may utilise different practices to allocate resources to projects and services. The article contributes to project contingency theory by revealing alternative resource allocation approaches in the specific organisational contexts of the project-based firms.

4.3 Integration of distributors in the delivery of complex systems

Article III highlights the role of distributors as central stakeholders in the milieu of project-based firms and points out the actions required to enhance integration in the downstream value chain of a project-based firm. The article offers an initial framework on the required distributor capabilities in complex system delivery and integration mechanisms. A qualitative case study was conducted with Company Beta.

4.3.1 Required distributor capabilities

The most important capabilities that the case company's distribution managers use to select and evaluate distributors are shown in Table 16. These capabilities can be categorised into four main groups: business, relational, marketing, and delivery. The most frequently stated capabilities are delivery and marketing capabilities. However, interviewees also noted the importance of financial capabilities as a central criterion for choosing distributors and relational capabilities as supportive requirements.

Table 16. Required distributor capabilities from the project-based firm's point of view (adopted from Article III)

Categories	Capabilities
Business capabilities	Financial capabilities
	Dedicated organisation or people
	Capabilities related to inventory management
	Capability of working with IT-based tools
	Capabilities of providing complementary products
Relational capabilities	Sharing product development opportunities
	Sharing market intelligence
	Enthusiasm and aggressiveness
	Commitment to development
Marketing capabilities	Market and industry knowledge
	Capabilities of managing customer relationships
	Sales capabilities
	Geographic coverage
Delivery capabilities	Technical knowledge and skills related to products and processes
	Capabilities of delivery services
	Capabilities of delivering customised solution / systems
	Capabilities of delivering commissioning and start-up

The results show that although all identified capabilities are integral to the firm, their importance may differ across various distributors, and capabilities may emerge and

evolve differently depending on the phase of the firm-distributor relationship. Table 17 categorises the capabilities into those that are required from the early stages of the project-based firm's relationship with distributors and capabilities that must necessarily evolve during the relationship.

The first group of capabilities are less negotiable, and the firm uses these capabilities as the basis for distributor selection or expects distributors to acquire the capabilities during the early stages of the relationship. Delivery capabilities for complex systems or commissioning and start-up are more significant in areas that have more developed and experienced distributors than new distributors. Relational capabilities, such as sharing market intelligence and product development opportunities, can be influenced by distributors' organisational culture.

Table 17. Categorisation of capabilities based on their evolving nature during the relationship

Required capability according to phase of the relationship	**Capabilities**
Capabilities that are required from the early stages of the relationship	Business capabilities Marketing capabilities Enthusiasm and aggressiveness (relational capabilities) Commitment to development (relational capabilities) Knowledge and skills related to products and processes (delivery capabilities)
Capabilities that are required to evolve during the relationship:	
Capabilities that are dependent on the length of the relationship	Capabilities of delivering customised solutions / systems (delivery capabilities) Capabilities of delivering commissioning and start-up (delivery capabilities)
Capabilities that are dependent on the culture of the distributors	Sharing market intelligence (relational capabilities) Sharing product development opportunities (relational capabilities)

4.3.2 Distributor integration mechanisms

In contrast to the traditional view that regarded distributors as customers that could add sales volume, the firm wants to have professional local partners. To accomplish this objective, the firm tries to develop relationships with its distributors. Table 18 contains a summary of actions that firms carry out to integrate with distributors. Some actions are more pertinent to the project level while others are at the business level.

4.3.3 Contribution of Article III

The article contributes to the research on inter-organisational relationships particularly concerning project-based firms and their distributors in project business. By categorising capabilities into those that are required from the early stage of the distributor relationship and those that evolve during the relationship, the study highlights the dynamism of distributor capabilities. The article describes a very different approach to integration mechanisms concerning distributors compared to previous research regarding suppliers. The stable position of distributors within the downstream value chain facilitates the use of integration mechanisms at the business level in addition to mechanisms at the project level. This characteristic and repetitiveness of projects highlight the function of a development-oriented integration approach in projects over time, which clearly deviates from the control orientation in supplier integration, possibly stemming from separate competitive tendering for each project.

Table 18. Summary of identified distributor integration mechanisms (adopted from Article III)

Integration mechanism	Description	Mechanism type
Project-level integration mechanisms		
Joint customer visits and meetings	Joint initial negotiation with customers	Cooperation-oriented
Support in developing proposals	Cooperate in preparing technical and financial aspects	Cooperation-oriented
Joint commissioning	Provide resources and on-site training for new systems	Cooperation- and development-oriented
Support for service business	Provide resources and on-site training	Cooperation- and development-oriented
Business-level integration mechanisms		
Evaluation of distributors	Annual evaluation of distributors based on specific criteria	Control- and development-oriented
Monitoring of distributors	Regular monthly or quarterly	Control- and development-oriented
Integrative ICT tools	Extranet portal to access business documents and tools	Control-oriented
Trust-building	Knowledge- and information-sharing	Cooperation-oriented
Informal activities	Day-to-day support through email, phone, and meetings	Cooperation-oriented
Training programme	On-site training, classroom training, and e-learning	Development-oriented
Development of suitable organisation	Finding and structuring suitable resources	Development-oriented
Shared offices for development activities	Irregular, temporary co-location with distributors	Development-oriented

4.4 Integrating services with solution offerings: Challenges and practices of sales work in project-based firms

Article IV explored the implications of service integration into solution offerings of project-based firms. This study complemented the earlier research by reporting the micro-processes of service-oriented solution selling and identifying the challenges that salespeople face when a project-based firm adds services to their offerings along with integration practices to enhance service integration into sales work. A qualitative case study was conducted with Company Alfa and Gamma.

4.4.1 Challenges of sales work when adding services to solution offerings

The findings identified four main needs in sales work when adding services to the solution offering: the need to manage the increased complexity of the offerings, the need to operate via complex sales routines, the need to gain confidence in the quality and accuracy of service delivery, and the need to align with customers' purchase preferences.

First, the respondents in sales organisations acknowledged that adding services to project offerings increased the complexity of offerings for the sales organisation as well as for customers. Project-related services could range from basic services, such as maintenance, to more advanced services, such as process optimization. Each of the possible services could also have different levels and prices that needed to be clarified for each project. The multitude of possibilities to modify the service package made the offerings quite complicated. This considerably increased the complexity of Company Alfa's solution offerings. Company Gamma, in turn, reduced the complexity of its offerings by including certain standard service modules for all solutions, including training and remote monitoring support.

Second, it might take a considerable amount of effort to convince customers to integrate services into the solution, and this is besides creating demand for the project. The number of visits across business units is rising, implying that to increase knowledge on competencies of internal resources, one must find suitable people from service units and collaborate with them during the sales work. Negotiation of project sales mainly concentrates on specific customers' needs, technical aspects of products, and price of the project. However, service sales negotiation requires data on the scope of the package, the implementation phase, the risks of not purchasing services, and the value of bundling projects and services. Thus, consultative and

value selling becomes critical to a successful sales negotiation. Furthermore, the sales force might have to negotiate with different groups of people from the customer's organisation for projects and services. The preparation of a suitable proposal for selling a life-cycle solution could also be different from preparing a product-driven project sales proposal. The sales force not only needs to understand the customer's needs and requirements, but also must analyse the customer's operation and environment carefully. Moreover, developing the terms and conditions for both projects and services becomes more complex and necessitates greater effort.

Third, project salespeople may have different concerns about service delivery. According to the interviewees from Company Alfa, some salespeople were not confident about availability of service people. This issue prevented them from marketing their service portfolio to all potential customers. Salespeople at Company Gamma had received complaints about the quality of the service delivery, especially for advanced technology service products. The lack of trust held by the salespeople in some services resulted in fewer attempts to integrate projects and services.

Fourth, based on some financial and contractual issues, some customers prefer purchasing the project with one contract and purchasing project-related services in another. While project sales usually happen during a period of short or long negotiation with customers, life-cycle solutions are not always a one-time sales process. As such, integrating projects and services can lead to some intervals in the sales process and increase the number of required negotiations with customers. Therefore, the sales force needs to proceed to the project execution phase and be prepared to close the second deal with the customer at a later, more conducive time.

4.4.2 Integration practices in sales work when adding services to solution offerings

Integration practices in sales work can be categorised into two general groups that can also be found in earlier research in somewhat different contexts: project-level integration and business-level integration to differentiate practices that were associated with a single project from practices that took place at the business level (building upon the categorisation of Sariola, 2018). To reveal the characteristics of the integration practices, each group was further divided into control-oriented, cooperation-oriented, and development-oriented practices (building upon the findings of Martinsuo and Ahola, 2010; Turner and Müller, 2004). Table 19 presents a summary of integration practices at Company Alfa and Company Gamma.

The identified project-level integration practices include cooperation-oriented practices through cross-functional sales work at the interface of sales and service units. Practices like joint customer visits, meetings, joint customer negotiation, and joint proposal development, helped both case companies elevate the level of collaboration between sales and service units during a single project. Such findings uncovered the important part played by key account managers in facilitating collaboration between business units and unifying efforts to deliver value to customers. The use of control-oriented practices, such as procedures, rules, control, and monitoring activities, were not highlighted during a project. The respondents did not reveal any specific development-oriented practices at the project level but acknowledged the effects of cross-functional sales work on developing their knowledge of service portfolios.

The findings also revealed different business-level integration practices. Use of control-oriented practices was less emphasised at the interface of sales and service units. However, Company Alfa developed a control programme by setting targets for cross-functional customer visits to improve collaboration between units. Cooperation-oriented practices included change in organisational structure, integrative roles, e.g., key account manager, shared offices, and using a common information-sharing platform.

First, changes in organisational structure may occur in different ways, like integrating product and service sales units in Company Alfa or adding specific people to sales units who are specialised in selling services at Company Gamma. Second, firms utilise a key account management approach for their major customers. The "key account manager" is responsible for taking care of the customer's requirements and integrating all the firm's efforts to deliver a suitable solution to the customer. Third, Company Alfa employed shared offices in certain regions where salespeople and service people are located in the same office. The respondents underscored the impacts of this practice on increased interpersonal communication between business units. Fourth, developing and employing a common information-sharing platform is another cooperation-oriented practice described by respondents. The sales and service units used separate unit-level systems to record and share information. However, the unit-level systems were only useful for a few types of business models, such as basic installed-base services or operations and maintenance outsourcing. The more integrated sales network for solution sales requires a common communication and information management system to share information about opportunities, initiatives, schedules, required resources, and so forth.

Table 19. Summary of integration practices at the two case companies (adopted from Article IV)

Categories	Company Alfa	Company Gamma
Project-level integration practices:		
Control-oriented practices		
Cooperation-oriented practices	Joint customer visits Meetings Joint customer negotiation Joint proposal development	Joint customer visits Meetings Joint customer negotiation Joint proposal development
Development-oriented practices		
Business-level integration practices:		
Control-oriented practices	Setting targets for salespeople to increase cross-functional sales work between sales and service units	
Cooperation-oriented practices	Changing organisational structure from two separate organisations for product and service businesses to integrated product–service sales units Integrative role: assigning key account managers to most of the key customers Shared offices for salespeople and service people in some regions Common customer relationship management system to support information-sharing	Adding service sales specialists to the sales unit Integrative role: assigning key account managers to a few key customers Common customer relationship management system to support information sharing
Development-oriented practices	Training workshops on service sales for all sales staff Specific sales material for services developed by service business	Informal ways and meetings to share best practices for selling services Set of information on the service portfolio developed by the service business

Development-oriented practices were implemented to respond to the need to manage increased complexity of offerings and sales routines. First, specific training workshops on service sales for product and project salespeople supply salespeople at Company Alfa relevant knowledge and information about the details of the service portfolio and how to proceed with customers. Company Gamma also used cross-functional meetings to discuss service portfolio and requirements of service sales. Second, for salespeople, one of the main obstacles to selling services was the lack of suitable and reliable information surrounding services. Developing sales materials that communicate clear information about the content and level of services available in the simplest way benefit project salespeople as well as customers.

4.4.3 Contribution of Article IV

Article IV contributes to the literature on life-cycle solutions by directing attention to the practice level of solution-selling and thereby offering an extension of the strategic and organisational views on moving toward solution business (Artto et al., 2008; Brady et al., 2005; Davies et al., 2006; Kujala et al., 2010). Identifying needs of service integration within sales work enhances the current understanding of how salespeople experience integrating services into solution offerings in practice. The literature has underscored the capabilities of system integration (Brady et al., 2005) and managing upstream and downstream relationships with suppliers and service providers (Hobday et al., 2005). This paper complements the system integration view, which centres around the scope and level of the offering with an integration of actors involved in solution sales. This paper contributes to the literature by characterising the role of actors that are not central in project delivery (i.e., sales and service units) and thus contrasting to the previous research that has studied the integration between actors that were involved in the project operations phase (e.g., Davies and Mackenzie, 2014). Finally, the paper contributes by mapping integration practices at both the project and business levels. The findings demonstrated the importance of project-level practices to enhance solution-selling (Artto et al., 2015) and further indicated the need for business-level integration to improve long-term relationships between business units to facilitate integrating services into solution offerings, developing required capabilities, and supporting project-level integration practices.

5 DISCUSSION

5.1 Integrating services with solution offering in the customer-facing phases of the solution life-cycle

The first research question inquired into how project-based firms integrate services with projects during customer-facing phases of the solution life-cycle, i.e., solution sales and delivery. This research provided empirical evidence on various challenges and needs that emerge in sales and delivery work of life-cycle solutions. Articles I, II, and IV explored the implications of integrating services with the solution offerings in the sales and service units of project-based firms. Previous research concerning the delivery of life-cycle solutions has mainly identified dispersed challenges regarding new capabilities, knowledge-sharing, and system integration that could be mapped at a strategic level and/or upstream activities of the project life-cycle (Davies and Brady, 2000; Brady et al., 2005; Jalkala et al., 2010; Huikkola et al., 2016). The evidence from Article I, II, and IV shows that, in practice, project-based firms that aim to implement solution-specific business logics struggle to integrate services in customer-facing phases, i.e., solution sales and delivery. For project-based firms, the implications of integrating services to the solution offerings could be guidelines for preparing for the possible changes and configuring suitable integration practices with internal and external actors in the downstream of value chain. These will be discussed in the following chapters.

5.1.1 Implications of integrating services with solution offerings in solution sales

This research, specifically Article IV, reveals that integrating services with solution offerings challenges solution sales and creates several integration needs in sales work. The studies on solution business indicated the need for managing customer information in order to meet customers' needs (Artto et al., 2015; Ståhle et al., 2019). This study demonstrates that managing customer information is one of the requirements for solution sales. However, the emergent challenges in sales work demands different interactions at the sales-service interface (Table 20). Table 20 illuminates solution sales by presenting what challenges exist in sales work, what

interactions are needed between units to overcome these challenges, and how to facilitate interactions through identifying integration needs.

Table 20. Challenges, interactions, and needs emergent from integrating services with solution offerings in solution sales (adopted from Article IV)

Challenges	Interactions between sales and services	Integration needs
Increased complexity of the offering	Information on service portfolio and potential proposal Information on product/system offerings and proposal	Need for collaboration between sales and service units Need for knowledge-sharing on service portfolio
Complex sales routines	Service sales know-how Sharing service sales resources Information on customers' needs and organisation	Need for collaboration between sales and service units Need for knowledge-sharing on sales know-how and suitable service resources
Lack of confidence in the quality and accuracy of service delivery	Information on service ability and availability	Need for communication and feedback channel between sales and service units
Product-centric sales	Service sales know-how	Need for developing service-sales capabilities
Customers' preferences	Information on customers' needs and organisation Information on project progress	Need for communication between sales and service units to be aware of proper sales period

Article IV indicated that adding services to solution offerings creates different challenges and demands in sales work. Project-based firms must organise sales activities to respond to challenges resulting from increased service orientation. Earlier research acknowledged the business advantages of solution delivery (Artto et al., 2008; Davies et al., 2006), but empirical research at the practice level of solution-selling is scarce. Through studying the sales work at the practice level, Article IV revealed potential source of challenges that could hinder solution-selling for project-based firms, including increased complexity of offerings, complex sales routines, lack of confidence in the quality and accuracy of service delivery, product-centric sales, and customers' purchase preferences. The identification of challenges at the practice level of sales work increases the current understanding of the experiences of salespeople in integrating services.

Article IV also highlighted the need to change the organisational setting of sales units. Prior literature acknowledged that transitions toward solution business needs alters various aspects of the organisation (Brady et al., 2005). By shedding light on solution sales, this research indicated several elements, including structure, infrastructure, individuals, and knowledge to facilitate solution sales. These arrangements influence collaboration between sales and service units. Empirical

evidence from Article II showed that service people can have active roles in the sales process and work closely with a sales unit. Sales and service units exchange information on customers' needs during the sales process. As finding suitable people at a customer's organisation is critical for solution sales, the units exchange details on a customer's organisation to identify decision makers and their needs. Sharing information on potential product and service proposal is also important in order to develop a final solution proposal. Article IV demonstrated the need to motivate service people to be involved in solution sales by sharing knowledge about service sales and transferring relevant information on the service portfolio. The actual sales process also requires sharing competencies and skills for selling services in terms of knowledge-sharing and/or service resource-sharing. Article II also indicated that the service and sales unit must exchange information in order to negotiate resource availability and improve the interaction between services and upcoming projects.

5.1.2 Implications of integrating services with solution offerings in solution delivery

This research emphasises the need for project-based firms to understand challenges and needs during solution delivery for successfully integrating services with the solution offerings. Prior studies on life-cycle solutions have often underscored the benefits of utilising and integrating service people at different stages of the solution life cycle (Artto et al., 2015). However, those challenges associated with this integration were less explored. Article II directed attention to the challenges in service units stemming from delivering uncertain service activities alongside planned project activities. The resource allocation issues involved in multiple delivery logics demands different changes in resource allocation practices, collaboration between project and service units, and knowledge integration. Table 21 illustrates what the main challenges are of service units, what interactions are necessary between units to address these challenges, and how to facilitate interactions to overcome the challenges.

Article II dealt with multiple delivery logics in service units at the practice level and indicated that allocating service unit people to deliver both project and service activities creates resource allocation obstacles. Although services are seen as unique offerings to the customers' needs in the same way projects are, their operations and processes can be highly routine and repetitive. It is possible and even typical that projects and routine activities compete for the same resources. Allocating resources

between different types of activities is not straightforward. The studies of matrix organising have established that resource conflicts and confusion over roles and responsibilities are possible between projects and functional line activities (Kuprenas, 2003; Laslo and Goldberg, 2008). Previous studies have mostly emphasised resource competition between projects in a project-based firm (Engwall and Jerbrant, 2003; Fricke and Shenhar, 2000; Zika-Viktorsson et al., 2006). This research identified two main challenges in the service unit during project and service delivery. First, the highly uncertain environment of service units results from dynamic customer requirements that necessitate re-prioritising activities continuously and potentially affecting resource availabilities for planned project activities. Second, changes and delays to projects require re-allocating resources between project and service activities.

Table 21. Challenges, interactions, and needs emergent from integrating services with solution offerings in solution delivery

Challenges	Interactions between project operations, sales, and services	Integration needs
Multiple delivery logics and high uncertainty in service units	Information on sales activities Information on service resource availability Information on required skills and competencies	Need for increasing employees' authority in decision-making Need for flexible resource allocation system Need for information systems
Changes in project plans and schedules	Information on project schedule and status Information on service resource availability	Need for communication between project operations and service regarding plans, delays, and resource availabilities

Taking a service unit's perspective, the findings of Article II presents different interactions between project operation, service, and sales units in solution delivery. In contrast to previous research that was concerned with how to use service capacity in project operations to enhance solution delivery (Artto et al., 2015; Ståhle et al., 2019), this research explored implications of solution delivery in service work and identified interactions and integration needs to address emergent challenges from service integration. Based on Article II, resource allocation processes in this dynamic environment must be modified to increase responsiveness to changes and customer requests as well as sharing information to enable accurate decision making. Previous work on dynamic environments emphasised the need for more flexible responses (Maylor and Turner, 2017) and improvising responses to changes (Jerbrant and Gustavsson, 2013). Such research suggests that increasing employees' authority in allocating their time can help service units organise within this uncertain

environment. Such an approach is in contrast with a top-down-oriented resource allocation where managers schedule and plan activities (Abrantes and Figueiredo, 2015) and it reflects more of a supervisory role for the managers. The increased part played by individuals in decision-making can decrease efficiency and increase anxiety if individuals are not educated about the firm's priorities or future projects. Sharing information and knowledge was the main type of interaction between units; the project organisation needed to know about resource availabilities and competency levels, so the service unit attempted to receive continuous information about project scheduling. Additionally, the service units expected to receive information on future project and service activities from the sales unit. Thus, the relationship-based and IT-based information-sharing between the manager and individuals was necessary to negotiate priorities and provide real-time plans. The internal information-sharing largely depends on cross-functional communication. Article II showed that proper communication and collaboration between project and service units to negotiate priorities between units and provide real-time project scheduling can balance responsiveness and nervousness.

5.2 Integrating internal and external actors within the downstream value chain

The second research question enquired into how project-based firms integrate internal and external actors in the downstream value chain. The business relationships in project-based firms is not limited to projects and requires integration and managing complex interfaces between multiple organisational units and firms (Gann and Salter, 2000; Skaates and Tikkanen, 2003; Turkulainen et al., 2013). Integration within project-based firms' supply chain has been a major concern, especially in life-cycle solution research (Aagaard et al., 2015; Ahola et al., 2017). However, the internal and external actors in the downstream value chain have not gained enough attention in the earlier literature. Figure 11 highlights the role of service units besides sales unit and project operations as well as distributors besides suppliers and customers in the project-based firm's value chain.

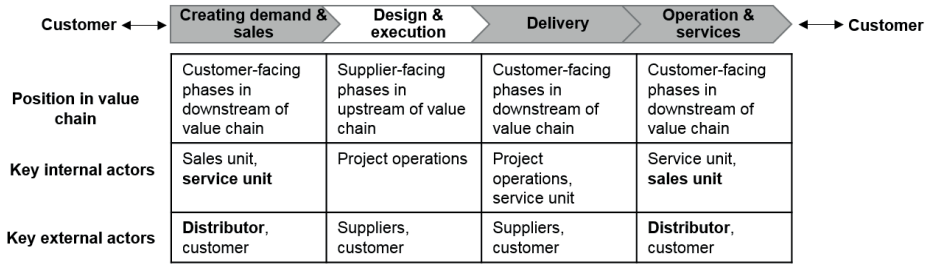


Figure 11. Key internal and external actors within the project-based firm's value chain

This thesis contributes to prior research by illustrating the practice level of integrating services in the solution sales and delivery of the project-based firms and listing the integration practices that can be used among different actors in the downstream value chain, including at the interface of project operations and services, sales and services, and project-based firm and distributors. The following chapters discuss internal and external integration. The integration practices are divided into two groups that can also be found in previous researches (Sariola, 2018): project level and business level. Project-level practices could be mapped to each phase of the project. Business-level practices are integrative practices concerning the business across and between projects. Majority of prior literature has focused on project and system level with less focus on business-related practices (e.g. Turkulainen et al., 2013). Business-level analysis helps to understand the required practices to enhance relationship with the other actor in the long term (as it is used by Sariola, 2018). More importantly for this research, with respect to the stable position of actors in the downstream value chain (which actually belongs to the permanent organisation) and the nature of service delivery that could last for tens of years (Artto et al., 2015), business-level analysis is critical to provide a broader life-cycle view of solution delivery to understand how project-based firms facilitate integration in the sales and service work that is out of scope of a single project. Each category is further divided into control-oriented and cooperation-oriented practices (in line with Martinsuo and Ahola, 2010). This categorisation is mainly used to uncover the nature of integration practices and provide the opportunity to compare integration practices in the upstream and downstream value chains.

5.2.1 Internal integration in the downstream value chain

This thesis shows that sales units and service units are active internal actors in the downstream value chain. The internal collaboration during customer-facing phases, i.e., sales and delivery phases, which were usually treated as the extended life cycle of the project, require particular attention from project-based firms. The requirements for system integration among functional units and at the supplier interface have been explored in previous researches with a focus on the design and execution phases of the solution lifecycle (Brady et al., 2005; Davies, 2003; Davies et al., 2007). Intra-organisational or cross-functional collaboration at project-based firms have been studied in prior research on new product development projects (Adler, 1995; Sicotte and Langley, 2000; Enberg et al., 2010; Adenfelt, 2010). Previous studies on system delivery projects also have stressed the need for internal integration and suggested different integration practices to facilitate it (e.g. Turkulainen et al., 2013). However, the research on internal integration in the delivery of life-cycle solutions is scant. The provision of life-cycle solution goes beyond the core project and includes various system components and services (Kujala et al. 2013). The service units in this study have an important role in selling and delivering solutions. Thus, project-based firms should be able to facilitate the integration of service units with sales units and project organisation, respectively, in solution sales and delivery. This thesis supports the notion that internal integration occurs through variety of integrative practices both at the project and business levels (Table 22).

The previous study highlighted the need for defining customer value in use at front end of projects (Smyth et al., 2018; Fuentes et al., 2019). The findings from previous literature on internal integration practices in solution sales highlighted the need for integration at the sales-service interface, especially to manage customer information flow between two units (Ståhle et al., 2019). Specifically, in Ståhle et al. (2019), personal involvement of salespeople and service people was determined as the main integration practice to communicate project and service opportunities between units. To respond to the challenges and needs that became evident in sales work, this research suggests using a number of types of integration practices.

Table 22. Internal integration practices at sales-service and project-operation-service interfaces

	Sales-service interface	**Project operation-service interface**
Project-level integration practices:		
Control-oriented practices		Project plan Flexible resource allocation systems
Cooperation-oriented practices	Cross-functional sales work	Integrative roles, e.g., project manager, service project manager Interpersonal communication
Development-oriented practices		
Business-level integration practices:		
Control-oriented practices	Setting targets for cross-functional customer visits	
Cooperation-oriented practices	Change in organisational structure Shared offices Integrative roles, e.g., key account manager Transferring knowledge on service content and values Using a common information-sharing platform Advanced ICT systems	Integrative roles, e.g., service manager, planner Using a common information-sharing platform Interpersonal communication
Development-oriented practices	Transferring service sales know-how	

The project-level practices enable use of service people in sales work. Through cross-functional sales work, the service unit is integrated into customer visits, customer negotiation, proposal development, and so on. While most of the previous studies on internal integration were concerned with cross-functionally integrating a project (e.g., Turkulainen et al., 2013), the empirical studies in Article IV show that project-based firms concentrate on the business level and using different control-, cooperation-, and development-oriented practices to enable integration of sales and service units. The business-level practices enhance interpersonal and organisational relationships and facilitate cooperation-oriented practices during a project. While previous studies on solution delivery have less reported the use of IT systems between units, Article IV described the need to use a common information-sharing platform to manage customer information and encourage personnel to integrate efforts through exchanging information on sales visits. The findings from Article I also suggested using advanced ICT systems as a knowledge-integration mechanism. Service units could utilise data from advanced ICT systems not only to improve maintenance (Jonsson et al., 2008, 2009; Westergren, 2011; Westergren and Holmström, 2012) but also to communicate sales opportunities to sales units, e.g. potential projects to modernise, upgrade, deliver a new system, etc.

Moreover, through investigating solution delivery from an organisational perspective, Article II demonstrated that solution delivery requires integration between project organisation and service units along with, to some extent, sales units to overcome the challenges emergent through integration of offerings. In comparison with the sales-service interface, the integration between project operations and service units focused more at the project level and has a more control-oriented approach. The main reason could be related to the nature of the relationship surrounding delivering planned activities to fulfil the requirements of a contract-based customer relationship. While previous studies focused more on project-level cooperation to enhance information-sharing, this study emphasises the need for cooperation between units at the business level and beyond a single project. For example, while previous studies put forth using integrative roles, such as a project manager, to share technical knowledge between functional units during system delivery (Turkulainen et al., 2013), the findings of Article II stipulated using an integrative role also at the business level to share knowledge and information between units to increase resource availability and enable resource allocation between units.

5.2.2 External integration within the downstream value chain

This thesis complements customer-oriented and supplier-oriented perspectives in supply chain integration by identifying the role of distributors as intermediaries between project-based firms and customers. With respect to the importance of maintaining customer relationship in times of discontinuities between projects (Hadjikhani, 1996), the relationship with distributors as solution sales and delivery channels were explored at the practice level. Compared to supplier and contractor relationships with project-based firms, which were mostly established by competitive tendering for a specific project (Martisuo and Ahola, 2010; Sariola and Martinsuo, 2016), the role of distributors is not limited to a project - they have a more stable position in the value chain. Article III indicated that project-based firms need multiple integration practices at the project and business levels. Table 23 presents different integration practices that can be used as a guideline for project-based firm to integrate with distributors.

Comparing distributor integration and supplier integration reveals interesting. For one, with supplier integration practices (e.g., Martinsuo and Ahola, 2010), the project-based firm has less control-oriented practices at the project level but it has

more business-level integration practices, such as monitoring and evaluating distributors, as well as development-oriented practices. For instance, establishing distributor management teams at the project-based firm suggests that the project-based firm must develop a specific organisation that consists of several regional teams to facilitate integration with distributors. This practice enabled implementation of new practices at the business level, including control-oriented practices (e.g., evaluation of distributors, monitoring of distributors), cooperation-oriented practices (e.g., trust-building), and development-oriented practices (e.g., shared offices for development activities). The importance of business-level practices were highlighted in utilising suppliers' innovation potential in construction projects (Sariola, 2018). The findings of this study recognised the importance of these practices to develop routines to aid distributors to act independently and cooperate smoothly with the project-based firm during projects.

Table 23. External integration practices with distributors

Categories	Integration practices
Project-level integration practices:	
Control-oriented practices	
Cooperation-oriented practices	Joint customer visits and meetings Support in developing proposals Joint commissioning Support for service business
Development-oriented practices	
Business-level integration practices:	
Control-oriented practices	Establishing distributor management teams at the project-based firm Evaluation of distributors Monitoring of distributors Integrative ICT tools
Cooperation-oriented practices	Trust-building Informal activities
Development-oriented practices	Training programme Development of suitable organisation for distributors Shared offices for development activities with distributors

Further, important factors that affect configuration of integration practices are quite different in relation to these actors. Prior research identified the temporal duration of the relationship and discontinuities between projects affecting the choice of integration practices (Martinsuo and Ahola, 2010). This study shows that the distributors' customer interface role and the repetitiveness of projects over time differentiate distributor integration; the distributors' integration practices evolve over time and the project-based firm has to monitor and modify integration practices for each distributor over the life cycle of a distributor relationship (Article III).

6 CONCLUSIONS

6.1 Contributions

This research makes contributions to two research streams: solution business research and supply chain integration research. Figure 12 summarises the key contributions of this work.

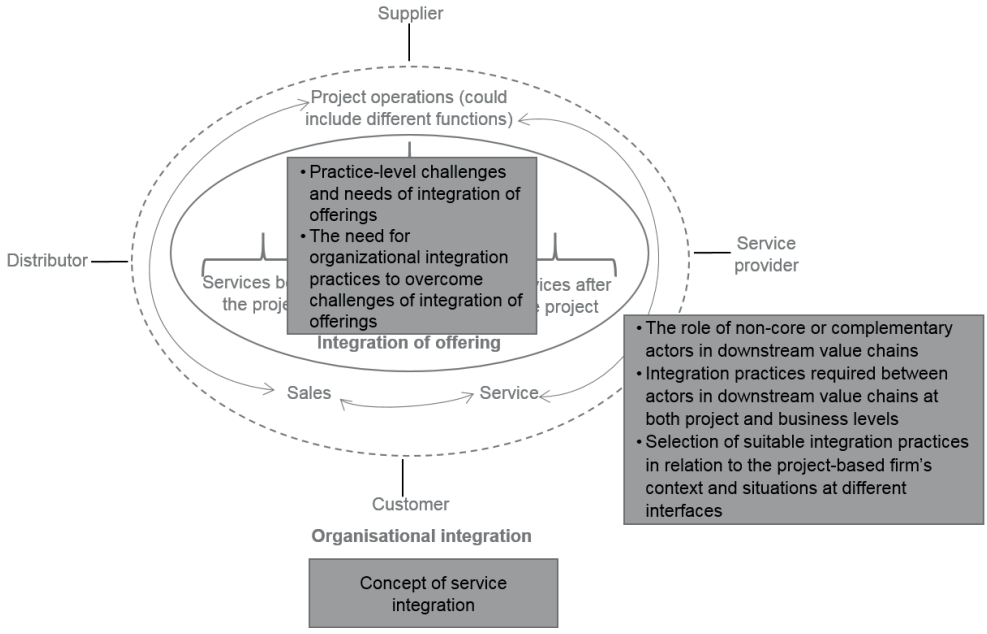


Figure 12. Contributions of this research on relevant research streams

6.1.1 Contribution to solution business research

This thesis makes two contributions to the solution business literature. The first is related to enhancing comprehension of customer-facing phases related to the downstream value chain, including solution sales and delivery. Most management and organisation problems involve multilevel phenomena (Hitt et al., 2007); solution business also encompasses both macro- and micro-level issues. Earlier literature has studied the implications of life-cycle solution offerings both conceptually and at the macro level (e.g., Brady et al., 2005; Artto et al., 2008). This thesis draws attention to

the micro level and contributes by improving the knowledge of the emergent challenges and needs from integrating services within solution offerings at the practice level of sales and delivery work. The required changes acknowledged in previous literature, such as customer orientation (Brady et al., 2005), developing capabilities (Hobday et al., 2005), and developing internal and external integration (Kujala et al., 2013; Huikkola and Kohtamäki, 2017), were illustrated in terms of integration practices that are conducted by business units at intra- and inter-organisational interfaces.

The second contribution relates to the discussion of integrating services in the business of project-based firms (Artto et al., 2008; Wikström et al., 2009; Kujala et al., 2013) by defining the **concept of service integration**. This study provides new insights into the **relationship** between **integration of offerings** and **organisational integration**. Previous research has determined a variety of integration practices at the in-bound and out-bound interfaces of project-based firms (e.g., Hietajärvi et al., 2017; Artto et al., 2015; Ståhle et al., 2019). The findings of this study further contribute to the existing research by increasing the understanding of how the integration of offerings creates a need for the integration of actors in the supply chain and how supply chain integration practices respond to the challenges and needs that emerge from the integration of offerings. The challenges of integrating offerings are mainly related to the offering, people, or the process. Table 24 indicates the connection between the integration of offerings and the integration of actors.

Concerning the differences in the individual challenges and suitable practices, in general, offering-related challenges, such as the increased complexity of offerings (Alderman et al., 2005), raise issues during solution sales and delivery and result in the need for interaction and collaboration at the interface of sales and service units as well as between project-based firms and distributors. The findings suggest using more cooperation-oriented practices during a project (indications from Article IV). Furthermore, the findings underscore the role of people as the backbone of the firm and show that people-related challenges, such as product-centric salespeople (Huikkola and Kohtamäki, 2017; Neto et al., 2015) or distributors, are critical issues during creating demand and solution sales that can considerably impact solution business. The findings show that a project-based firm must address these challenges through implementing a variety of integration practices not only within a project but at the business level (indications from Articles III and IV). Process-related challenges occur both at the solution sales and delivery phases and primarily result from different business logics and procedures that are implemented in varying business units (Artto et al., 2015; Brady et al., 2005; Gann and Salter, 2000). These challenges

are mainly responded to via employing plans, systems, or formal and informal communication during a project as well as at the business level (indications from Articles II, III, and IV).

> Proposition 1: For project-based firms to be efficient in service integration, their organisational integration practices need to be adjusted to their specific integration challenges.

Table 24. Integration practices to overcome challenges emergent from integration of offerings

Implications of integration of offerings	Organisational integration practices
Offering-related challenges *e.g., increased complexity of offerings*	Cooperation-oriented practices at the project and business level *e.g., cross-functional sales work; transferring knowledge on service content and values; joint customer visits and meetings; support in developing proposals; joint commissioning; support for service business*
People-related challenges *e.g., lack of confidence in the quality and accuracy of service delivery; product-centric sales people or distributors*	Control-, cooperation-, and development-oriented practices at the business level *e.g., setting targets for cross-functional customer visits; change in organisational structure; shared offices for sales and service units; integrative roles, e.g., key account manager; transferring service sales know-how; interpersonal communication; training programme for salespeople; development of suitable organisation for distributors; shared offices for development activities with distributors*
Process-related challenges *e.g., complex sales routines; multiple delivery logics and high uncertainty in service units; changes in project plans and schedules*	Control- and cooperation-oriented practices at the project and business levels e.g., using a common information-sharing platform; project plan; flexible resource allocation systems; integrative roles, e.g., project manager, service project manager; interpersonal communication

6.1.2 Contribution to supply chain integration research

This thesis offers three main contributions to the supply chain integration literature. The first is related to increased understanding of **integrating non-core or complementary actors** in the **downstream value chain** of project-based firms **at the practice level**. The second relates to analysing integration practices at the **project** and **business levels**. The third contribution relates to understanding **the use of integration practices** in relation to the project-based firm's **context** and **situations** at different interfaces.

Integration of actors in solution business research has already explored the integration between actors involved in project operation (e.g., Davies and Mackenzie, 2014). This thesis contributes by increasing understanding of the role of non-core or complementary actors in offering life-cycle solutions, their challenges, and integration practices. Solution business research has most concentrated on system integration within a project-based firm's upstream value chain (e.g., Davies et al., 2007). This thesis draws attention to downstream value chain and internal and external actors that are involved in service integration during the customer-facing phases of solution lifecycle.

This thesis contributes overall by considering both project-level and business-level practices in integrating internal and external actors. Prior literature has mainly focused on project-level integration and there have been less research on business-level integration in project-based firms (Sariola, 2018). The findings demonstrate that while project-level practices aim to support day-to-day solution sales and delivery activities, business-level practices seek to enhance the long-term relationship between actors and develop their capabilities to facilitate integrating services to solution offerings. The predominance of business-level practices could be because of the position of sales and service work within the downstream value chain. Combining the findings from this research and along with previous research on solution delivery (e.g., Turkulainen et al., 2013; Artto et al., 2015; Ståhle et al., 2019) led to the following proposition (Adopted from Article IV):

> Proposition 2: The level of project-based firm's integration practices in service integration varies over the life cycle of a project. Business-level integration practices predominate during the customer-facing phases, i.e., sales and delivery, and project-level practices predominate during the supplier-facing phases, i.e., during project execution.

Further analysis of control-oriented practices in light of previous research on the forms of control in organisations (Snell, 1992; Cardinal, 2001) shows the existence of input, process, and output control in integration practices. The findings of this study confirm that an organisation does not use a single form of control but combines them to influence reaching the desirable goal (Cardinal, 2001). At intra-organisational interfaces, both the output control (e.g., project plan, targets for cross-functional customer visits) and process control (e.g., flexible resource allocation systems) were identified (indications from Articles II and IV). The dominance of output control, and even the flexibility of process control, among business units

shows that the firms try to decentralise control by setting targets instead of standard operating procedures (Snell, 1992). However, analysing the control-oriented practices between the firm and distributors revealed the dominance of process control at the inter-organisational interface (e.g., evaluation and monitoring of distributors) (indications from Article III). Process control helps the organisation to retain a structured information flow and to avoid misinformation among actors (Hood, 1991). This type of control requires centralisation (Cardinal, 2001); establishing distributor management teams at the project-based firm is one example of a more centralised structure that enables close supervision (Snell, 1992).

> Proposition 3: The type of a project-based firm's control-oriented practices in service integration varies depending on the need for supervision (monitoring, developing, and supporting). Process-control practices predominate at the interfaces with a higher need for close supervision, and output-control practices predominate at the interfaces with less need for supervision.

While the scope of this study did not cover the indications of input control through staffing, some development-oriented practices could be considered as one form of input control (Snell, 1992). Training programmes as a formal system aim to develop knowledge, skills, and abilities for certain tasks and, thus, could be considered as input control. However, the identified development-oriented practices in this study encompass a wider range of actions that are not necessarily formalised or structured practices.

Reflecting on the previous literature on organisational collaboration reveals the two aspects of collaboration, namely, cooperation and coordination. The cooperative actions aim to align different incentives and motivation to do a task (Gulati et al., 2012). The coordination actions concentrate on completing the task itself and coordinating the efforts of actors to work for the same goal (Turkulainen et al., 2013). This study confirms the findings of previous research and elaborates the findings on organisational integration practices. When further analysing the cooperation-oriented practices, the findings indicate that at the project operations-service interface, the main concern is aligning the efforts to perform project activities through coordinate practices that focus on information sharing (e.g., using a common information sharing platform, integrative roles) (indications from Article II). However, at the sales-service interface, the project-based firms need to overcome the trust issues and conflicting interests between units through cooperative practices

(e.g., transferring knowledge on service content and values) (indications from Article IV). The findings also highlight the use of cooperative practices, such as trust-building and informal activities to decrease conflicts and trust issues (Davis, 2016) between the firm and distributors (indications from Article III).

> Proposition 4: The type of a project-based firm's cooperation-oriented practices in service integration varies depending on the level of trust and conflicting interests among actors. Coordination practices predominate at the interfaces with a higher level of trust and less conflicting interests. Cooperative practices predominate at the interfaces with a lower level of trust and more conflicting interests.

The literature on operations management, organisational change management, and strategy management often discuss planned changes and emergent changes. While planned changes rely on objectives and methods, emergent changes have a more processual approach and are less prescriptive (Bamford and Forrester, 2003). Earlier work in supply chain integration has acknowledged that integration practices vary during the project life cycle (Turkulainen et al., 2013; Ståhle et al., 2019). The previous studies on stakeholder management has also highlighted the emerging interaction patterns during a project and the need for fine-tuning relationship competencies over time (Vaagaasar, 2011). However, the changes in organisational integration practices at the business level and, more particularly, the development of organisational integration practices were less explored in previous studies. This thesis utilises the concept of planned and emergent changes in the organisations and contributes to previous research in supply chain integration by differentiating between organisational integration practices that are planned systematically and those that are emergent and/or developed incrementally over time. However, it should be noted that the successful emergent integration practices may be developed incrementally over time and become part of the integration plan.

The findings of Article III show that while project-based firms employ some planned integration practices, such as the distributors' evaluation and monitoring for more experienced distributors, they cannot predict all of the integration needs of new distributors and define suitable practices proactively. Therefore, on many occasions, especially during a project, the project-based firm must appreciate the situation and establish appropriate practices to respond to needs instantaneously. Some examples of the emergent practices in this study are joint commissioning, support for service business, shared offices for development activities, and so on.

One reason could be that distributors are independent entities, and the project-based firm cannot implement all desired procedures and standards within the distributors' organisations.

> Proposition 5: The use of planned organisational integration practices in project-based firms varies by the level of the distributors' experience. Planned integration practices predominate in their relationship with experienced distributors, and emergent integration practices predominate in their relationship with new/less experienced distributors.

In this research, planned practices were more evident in Article IV, e.g., shared information processing systems, changes in organisational structure, setting targets for cross-functional customer visits, and so forth. Project-based firms usually have a clear goal, procedure, or schedule regarding the use of these practices. Analysing internal integration practices in more detail by studying Company Alfa in Articles II and IV revealed that the business units used emergent practices more at the interface of project operations and services while they applied more planned integration practices at the interface of sales and services. Higher uncertainty at the project operations-service interface could be a reason for the emergent integration. Such findings led to the following proposition:

> Proposition 6: The use of planned organisational integration practices in project-based firms varies by the level of uncertainty at different interfaces. Planned integration practices predominate at the interfaces with low uncertainty, and emergent integration practices predominate at the interfaces with high uncertainty.

6.2 Managerial implications

This study encourages project-based firms to pay attention to the downstream value chain and consider solution sales and delivery as crucial steps for integrating services with a solution offering. The study reveals that project-based firms face various challenges at sales-service, project operation-service, and project-based firm-distributor interfaces. Further, the study suggests different practices that facilitate integration across internal and external actors. Table 25 summarises all findings herein regarding implications of service integration and internal and external

integration practices in the downstream value chain of project-based firms. Project-based firms could leverage these practices to enhance integration of offerings. Bundling project and service components cannot always promise successful solution business, but project-based firms must activate the relationship through integration practices between organisational units as well as with external actors.

This study uniquely indicated the role of distributors as intermediaries between a project-based firm and customers. Article III provided a concrete list of the expected distributors' capabilities (Tables 16). Project-based firms may refer to these as a guideline for selecting and evaluating distributors. The study also offered evidence that distributors' capabilities evolved from basic capabilities during the early phases of the relationship to more advanced capabilities for delivering complex solutions (Table 17). Project-based firms must go beyond control- and cooperation-oriented practices and invest in developing distributors' capabilities.

This study emphasises the importance of business-level practices in integration between actors. Business-level practices enhance the relationship between actors and improve integration practices during a project. Therefore, project-based firms should promote business-level integration by fostering an appropriate organisational setting that support knowledge and organisational integration across various interfaces. Especially regarding external integration with distributors, this study provides support for project-based firms managing integration with distributors at the business level to develop long-term relationships with distributors and develop their capabilities in solution business. Furthermore, the current work encourages the use of organisational integration to ensure the efficient use of competencies and skills required for solution sales and delivery. Project-based firms have to customise their integration practice portfolio over the solution life cycle and across internal and external interfaces. The defined propositions in this research might assist project-based firms analyse situations and organise integration efforts accordingly.

Table 25. Summary of findings on the implications of service integration within the downstream value chain of project-based firms

		Solution sales	Solution delivery
Challenges		Increased complexity of the offering Complex sales routines Lack of confidence in the quality and accuracy of service delivery Product-centric sales Customers' preferences	Multiple delivery logics and high uncertainty in service units Changes in project plans and schedules
Integration needs		Need for collaboration between sales and service units Need for knowledge-sharing on service portfolio Need for knowledge-sharing on sales know-how and suitable service resources Need for communication and feedback channel between sales and service units Need for developing service-sales capabilities Need for communication between sales and service units to be aware of proper sales period	Need for increasing employees' authority in decision making Need for flexible resource allocation system Need for information systems Need for communication between project operations and service regarding plans, delays, and resource availabilities
Internal integration practices	Project level	Cross-functional sales work	Project plan Flexible resource-allocation systems Integrative roles, e.g., project manager, service project manager Interpersonal communication
	Business level	Setting targets for cross-functional customer visits Change in organisational structure Shared offices Integrative roles, e.g., key account manager; Transferring knowledge on service content and values Using a common information sharing platform Advanced ICT systems Transferring service sales know-how	Integrative roles, e.g., service manager, planner Using a common information-sharing platform Interpersonal communication
External integration practices	Project level	Joint customer visits and meetings Support in developing proposals	Joint commissioning Support for service business
	Business level	Establishing distributor management teams at the project-based firm Evaluation of distributors Monitoring of distributors Integrative ICT tools Trust-building Informal activities Training programme Development of suitable organisation for distributors Shared offices for development activities with distributors	

6.3 Validity and reliability of the research

The choice of research methods and data collection limits the validity of findings, which must be acknowledged. First, the articles are based on a limited number of cases. The case studies were conducted through a small number of interviews at each company. The validity and reliability of a qualitative study is evaluated through credibility, dependability, confirmability, and transferability (Lincoln and Guba, 1985).

The validity of findings were improved by selecting cases that were representatives of their industries. The interviewees were chosen with the help of a knowledgeable contact person to assure that respondents had much experience and knowledge of the research topic. Credibility was made certain through close collaboration with company representatives, sharing findings with the companies, holding workshops, and presenting findings for practitioners at seminars. The confidentiality agreements between the university and companies led to very open information-sharing by the informants. Furthermore, the articles were published in peer-reviewed scientific journals; blind peer-reviewed and modified based on reviewers' feedback.

The dependability of this research was assured by recording and transcribing interviews (Silverman, 2006). In this way, traceability of the insights was increased. Dependability was further fostered by storing the records and transcripts while updating a research log to keep track of the data collection. Using excerpts from the interviews in the original articles also enhanced transparency of the research.

To improve confirmability and eliminate any bias, the interview questions were reviewed by company representatives to be confident the questions were unambiguous and understandable. The research goals and interview outline was also sent to the interviewees before all interviews. The interview questions were open-ended and the researcher did not lead the informants in their answers. Subsequently, the results were discussed with the co-author, the research team and the company representatives.

Finally, to ensure transferability, cases and data were explained thoroughly in the original articles to enable judgments surrounding the transferability of the research results (Lincoln and Guba, 1985). These results were presented in three seminars, wherein multiple industrial companies from various industries participated. The means by which to assure the validity and reliability of this research are listed in Table 26.

Table 26. Different means to ensure validity and reliability of the research

Criteria	Means to ensure validity and reliability of the research
Credibility	• Selecting interviewees with the help of a knowledgeable contact person • Close collaboration with company representatives • Sharing findings with the companies • Holding workshops • Presenting findings to practitioners at seminars • Keeping confidential agreements • Articles accepted in peer-reviewed scientific journals
Dependability	• Recording and transcribing interviews • Storing records and transcripts while updating a research log • Using excerpts from the interviews in the original articles
Confirmability	• Reviewing the interview questions with company representatives • Sending the research goals and interview outline to all interviewees before interviews • Using open-ended interview questions and not leading the informants in their answers • Discussing the findings with the co-author, research team and company representatives.
Transferability	• Explaining cases and data in detail in the original articles • Presenting the findings at seminars with multiple industrial companies from different industries

6.4 Limitations and suggestions for further research

This research was limited by its organisational context, choice of theoretical lens, selection of organisational perspective, and research methods and data collection, which encourages and suggests future research ideas. In particular, this work was conducted with project-based firms in the engineering and technology industries. These firms provide repetitive projects to their customers and service business has a crucial role for them. The findings of the research are highly likely to be transferrable to a similar context. However, the organisational context of the case companies should be considered when evaluating the applicability of these findings into another context. The cases, their business contexts, and data collection procedures were explained in detail to allow readers to interpret the applicability of the findings. Further research is merited to study other types of project-based firms to explore similarities and differences in integration of offerings and actors.

This thesis applied the perspective of solution business and supply chain integration as its theoretical lenses. Although it made new contributions and produced insights into these research streams, this work leaves contributions to other research domains for future research. For example, knowledge and

organisational integration, as well-established research streams, were assessed from a narrow theoretical perspective. Moreover, future studies could contribute to the discussion in information processing theory to investigate the impacts of downstream integration practices on several aspects of a project-based firm's performance. Further research is warranted to evaluate the governance of project-based firms, especially in relation to distributor relationships. The results of this study show that firms create new roles, teams, and structure to manage integration. More research is necessary to measure various organisational designs in different contexts.

The findings of Article IV showed the existence of multiple sales models at project-based manufacturing firms. The previous literature also explored multiple solution-specific business models at project-based firms (Kujala et al., 2010). It would be of interest to investigate sales models in relation to different business models. Additional research is recommended on these sales models, their connections, the contingencies relevant to solution-specific business models, and ways to manage solution-selling in different business models.

The development of new capabilities was a main issue raised in the case studies, but except Article III that explored required distributors' capabilities, the capability issue was only partially considered in the other articles. Further investigation is therefore suggested to assess the operational capabilities required in solution sales and delivery along with the ways to develop them at project-based firms. Future studies could assist project-based firms connect strategic capabilities for solution business to operational capabilities in different parts of the value chain.

This study explored the implications of integrating services in solution offerings and required integration practices, and thus expanded an already vibrant area of research concerning the orientation of project-based firms to solution business. However, the research evaluated service offerings in general and did not differentiate types of services. It would be of intrigue to study how firms integrate different types of services, e.g. ICT-based services, highly customised services, etc., in their solution offerings and, subsequently, how integration practices could vary in terms of type of service.

This study used a single level of analysis to analyse the service integration of project-based firms. Future research would benefit from a multi-level analysis of the phenomena by integrating micro- and macro-level analyses. Moreover, the study of the changes and connections of practices is recommended to see how the practices interrelate over time and how the relationships between different actors are affected by and affect the practices in use.

Finally, the study follows project-based firms' perspective, thereby delimiting the findings. Other perspectives, such as customer and distributor points of view, could complement the research. Additional enquiry is suggested to explore the perception of distributors regarding efficiency of project-based firms' integration practices. The studies that were concerned with internal integration explored integration issues from sales and service units' perspective while project operations were not included in the study, potentially restricting validity of the findings. Moreover, the study was based on a dyadic relationship between actors. Future research should determine different points of view in a triadic setting simultaneously. Studying the triad of project-based firms, intermediaries (e.g., distributors), and customers could provide fruitful insights into the interaction between the various requirements and expectations from integration of offering and integration of actors within the value chain. It is also necessary to investigate how project-based firms' customers regard integration of offerings in their business. Studying the triad of project sales, services, and customers could be quite interesting. A case study on this triadic setting might improve understanding of the dynamics between customers' needs and project-based firms' business models, managing the effects and needs of internal and external integration simultaneously, and identifying required integration capabilities.

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PUBLICATION I

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Remote monitoring in industrial services: Need-to-have instead of nice-to-have

Khadijeh Momeni and Miia Martinsuo

Tampere University of Technology, Tampere, Finland

Abstract

Purpose – The purpose of this study is to better understand the efficient use of remote monitoring systems (RMS) to create business value for industrial services in manufacturing firms. A business view to RMS is a key prerequisite for the successful application of the Internet of Things (IoT) in industrial services.

Design/methodology/approach – A qualitative multiple-case study was conducted in six engineering companies. The main source of data was semi-structured interviews with 16 managers.

Findings – The findings highlight the role of RMS in enabling manufacturing firms to collect data from customers to complement their limited knowledge about their customers. The study demonstrates the business value of using RMS in industrial services, and the necessity of capturing the business value through advanced IT technologies.

Research limitations/implications – The qualitative research design and choice of six target companies limit the findings to business-to-business manufacturing firms. Further, the focus is on the manager's viewpoint. The findings imply new business value through an efficient use of RMS to complement direct customer contact.

Practical implications – The study draws attention to the skilled use of advanced RMS and information and communication technology (ICT) as a prerequisite for the successful application of the IoT in manufacturing firms that provide services for complex solutions and customers dispersed globally.

Social implications –

Originality/value – The research shows that utilising information collected through RMS is an important factor in creating business value in a manufacturing firm's customer relationships. The study contributes by integrating RMS into the customer information collection process to increase the amount, validity, and quality of data.

Keywords Customer information, services, remote monitoring systems, internet of things

Paper type Research paper

Introduction

In today's business-to-business (B2B) environment, a manufacturing firm cannot be successful by only focusing on its products; it needs to complement its products with various services. The implementation of advanced information and communication technology (ICT) to improve service delivery has received increased attention in manufacturing firms' operations. An important managerial issue is how manufacturing firms can create business value through these advanced technologies. Business value includes not only the productivity payoff from the technology, but also its impact on critical business activities, such as production, sales and marketing, and customer services (Mukhopadhyay et al., 1995; Tallon et al., 2001). This study focuses on remote monitoring systems (RMS) as representative of advanced ICT in manufacturing firms. Previous RMS research has primarily focussed on its technical enablers and condition monitoring. There is a need go beyond its technical implications and to understand RMS' broader implications on other business activities in manufacturing firms.

To achieve business value, manufacturing firms need to ensure the efficient delivery of customer value. According to Grönroos (2011), customer value is not only dependent on the main product, but also the entire range of relationships between the customer and the firm that supports the effective use of the main product. Thus, customer collaboration is vital in the B2B context. Customers provide a wide range of skills, competencies, interests and knowledge (Blazevic and Lievens, 2008), which can be acquired in different ways. Blazevic and Lievens (2008) argue that the majority of previous studies on the customer's role in innovations focus on face-to-face meetings, interviews, focus groups, and surveys. Collecting information through these methods can be expensive, time consuming and ineffective when considering a B2B environment with all its networks and interrelationships. Technological developments provide new opportunities for acquiring required data and information from the customer. Advances in sensors and communication technology have led to the effective collection and transmission of data and, subsequently, to transforming it to reusable knowledge (Westergren, 2011).

Over the past years, utilising sensors and sensor networks in the industrial sector has been in high demand in different business environments. Multiple technologies use sensors to enable services, including radio-frequency identification (RFID), machine-to-machine (M2M) communication, wireless sensor networks (WSNs), RMS, etc. All these systems have some similar elements, but they have some differences at the automation and function levels. The

Internet of Things (IoT) is an umbrella term that encompasses these supporting technologies as well as other domains, including Internet technologies and applications of technologies (Miorandi et al., 2012). The IoT can be applied in several fields, such as environmental monitoring, smart cities, smart business, inventory and product management, smart homes, smart building management, healthcare, and security and surveillance (Atzori et al., 2010; Miorandi et al., 2012; Gubbi et al., 2013).

Previous research has covered some business applications of the IoT, such as automation and industrial manufacturing, logistics, business/process management, and intelligent transportation of people and goods (Atzori et al., 2010). Previous studies on the IoT have mainly concentrated on its technological enablers and have investigated novel ways to collect and analyse data. Technological enablers are "nice-to-have", but they require much more to convert the IoT into new business opportunities. Some research studies have addressed the productivity gains from using ICT for services (Kowalkowski, 2008), but they have not covered RMS. Little research has explored business enablers and feasible ways to use the substantial amount of data efficiently, transform data into knowledge that enables the creation of new business, and develop new solutions in industrial manufacturing. This aspect of the IoT is the "need-to-have", and it enhances the use of technology for manufacturing firms involved in industrial services.

This study sheds light, in particular, on RMS as the most typical solution to enable services in industrial firms. RMS are technology-based advanced sensors and information solutions that enable service delivery in manufacturing firms. RMS help companies to receive data from the installed base of equipment by remotely monitoring the products and their use from anywhere in the world. The literature on sensor-based systems has explored various applications, such as conditions monitoring, that enable services in an industrial environment (Kurada and Bradley, 1997; Owen et al., 2009; Vogl et al., 2009; Bogue, 2011, 2013; Gomes et al., 2013). Previous research has also addressed applications of RMS for predictive maintenance (Lee, 1998; Jonsson et al., 2008, 2009; Westergren, 2011; Westergren and Holmström, 2012). However, RMS applications to enhance service business have not been thoroughly studied. Customer-oriented companies might use RMS for their internal purposes, but of particular interest is using them in a manufacturing firm's customer relationships. Such usage may enable manufacturing firms to offer new services to their customers, optimise the service delivery process, and activate completely new businesses.

The research goal and questions

This research focuses on manufacturing firms using the data collected through RMS to enhance their industrial service business. The purpose is to characterise ways in which companies can utilise RMS to enhance the use of customer information and create business value. The study shows that RMS are no longer *nice-to-have*, but that manufacturing firms *need to have* access to the real-time data from their installed base and to analyse the potential of using the remote data to enhance their service business. The following two research questions are addressed:

1. How do managers in manufacturing firms perceive the business value of RMS in industrial service business?
2. How do RMS along with other data collection channels help manufacturing firms to identify customers' needs and expectations in service business?

The empirical study focuses on manufacturing firms delivering complex systems and complementing their offering with services for business customers. Therefore, the focus is on a B2B environment, and consumer businesses are not considered. The research was conducted as a multiple case study in six large international firms with large global installed bases of equipment. Interviews were conducted with managers and, thus, the viewpoint is managerial.

Most prior studies have concentrated on the customer's benefits from RMS (Wu et al., 2006; Wang et al., 2007). This paper contributes by developing an understanding of how manufacturing firms can utilise RMS to create business value in their service business. This study highlights the manufacturing firms' business value through processes and customer information use, and analyses how they can improve their business through technology-enhanced services. In particular, the paper demonstrates the role of customer information in service business and explains how RMS can assist manufacturing firms in collecting and analysing relevant and valid customer information.

The remainder of the paper is organised in the following manner. First, a review of extant literature is provided to increase the understanding of the role of customer information in service business and applications of RMS. Then, the theoretical understanding is developed further with an empirical multiple case study. Finally, the implications of the findings are discussed, key contributions are reported, and the research limitations and suggestions for further research are presented.

Literature review

Manufacturing firms moving toward service business

Manufacturing firms in the B2B market offer various services to their customers (Mathieu, 2001). Services can greatly influence and complement a product's functionality, and their value can surpass the price, which comes as no surprise to many firms (Küssel et al., 2000). In addition to the value of the main product, customer value in a B2B environment is influenced by various types of relationships between the customer and the firm, supporting the effective use of the main product (Grönroos, 2011). Services can improve a firm's competitive position, making it hard for competitors to imitate the solution (Chesbrough and Davies, 2010). In contrast with a goods-dominant logic that proposes distinct roles for the supplier and the customer, service-dominant logic relies on interactive relationships between these two parties to create value (Vargo and Lusch, 2008). A firm that subscribes to service logic is involved in the customer's practices and business processes, meaning that they provide extended offerings to the customer to create value. Therefore, the firm provides business effectiveness instead of operational efficiency (Grönroos, 2011). In organisations that deliver complex systems and integrated solutions, goods-dominant logic and service-dominant logic typically coexist (Windahl and Lakemond, 2010).

The integration of services and products has attracted substantial attention in many industries (Davies et al., 2006; Lenfle and Midler, 2009). An integrated solution is a bundle of physical products, services and information. These long-term and cost-effective solutions fulfil a specific functional need for the customer (Brax and Jonsson, 2009). When manufacturing firms provide integrated solutions, they need to understand how customers see the value of the solution (Brady et al., 2005). Customers do not just buy an integrated package; they also pay for trouble-free operations (Davies et al., 2006). Customers focus on the lifecycle costs of the solution and its performance, and seek a more long-term commitment (Kujala et al., 2010). This view requires more attention to be paid to customer relationships and the related value-adding activities, because manufacturing firms are no longer passive receivers of the customers' specifications (Brady et al., 2005). A topical issue is how modern technologies, such as the IoT and RMS, enable manufacturing firms' service businesses and the creation of business value in their customer relationships.

The IoT and RMS as technology enablers for service business

The development of various information and communication technologies (ICTs), such as WSNs, RMS, RFID and M2M, aims to enhance the exchange and analysis of massive amounts of data in different industries. The dynamic networks of devices form the IoT and feature such key components as sensing, heterogeneous access, information processing, applications, and services (Chen et al., 2012). The IoT is mainly about exchanging and analysing massive amounts of data (Miorandi et al., 2012). Thus, IoT technologies enhance data collection abilities considerably. New types of sensors help to detect information that people cannot and also to collect information anytime and anywhere (Chen, 2012).

This paper explores the business value of the data collected through IoT technology as an important area in industrial service business. RMS are the most typical solution for enabling services in industrial firms. RMS are a collection of sensors and data transmitters that are placed on the products and enable the manufacturer to monitor products from a distance, collect data to create services based on data analysis, and improve their understanding of product utilisation (Westergren, 2011). RMS can provide business value both for the manufacturing firms and customers. Some of the identified dimensions of value in previous research include improving customer relationships, generating new turnover (Küssel et al., 2000), reducing after-sales costs (Biehl et al., 2004), increasing machine uptime (Jonsson et al., 2008; Westergren, 2011; Westergren and Holmström, 2012), and improving safety (Wu et al., 2006).

Most of the previous research on RMS and sensor-based solutions have used a literature review as their main methodology, and they tend to be more technical and place less focus on service opportunities or the business value of the solutions (Kurada and Bradley 1997; Everall et al., 2000; Sion and Atkinson, 2002; Owen et al., 2009; Vogl et al., 2009; Bogue, 2013; Gomes et al., 2013; Huang, 2014). However, some valuable single case studies have focussed on applying RMS to monitor an installed base of equipment at the customer's location (Nieva, 1999; Mori et al., 2008; Jonsson et al., 2009; Westergren, 2011; Westergren and Holmström, 2012), open innovation and trust as a key precondition for openness between the manufacturers and customers (Westergren, 2011; Westergren and Holmström, 2012), the use of IT solutions to provide value-adding services in industries, and the role of customers to become either co-creators of value or receivers of the created value (Jonsson et al., 2008, 2009; Kowalkowski and Brehmer, 2008). Such studies have shown that manufacturing firms face many requirements and challenges in deploying RMS and convincing customers to accept and implement the technology. Adopting the IoT is necessary for the manufacturing firms'

customers to gain the full benefit of services and for the manufacturing firms to achieve business value.

IoT adoption in the manufacturing firm's customer relationships

Advances in technology and industrial structures enhance the applications of the IoT. Industries try to use IoT devices to develop industrial applications such as automated monitoring, control, management and maintenance (Da Xu et al., 2014). However, IoT applications are at an early stage and quite a few applications are being developed or deployed in different industries (Da Xu et al., 2014). Thus, studying IoT adoption in this developing environment can help industries benefit from IoT solutions.

Technology adoption has received attention in various technological domains, including IT and related applications (DeSanctis and Poole, 1994; Orlikowski, 2000; Forman and Lippert, 2005; Hernandez et al., 2009). Achieving business value from technologies requires that customer firms adopt them, i.e. are willing to purchase and use them. In line with general theories of technology diffusion (Rogers, 1995), many studies associate various firm-level and contextual antecedent factors to the overall degree of adopting a certain technology (Patterson et al., 2003; Fuentelsaz et al., 2003; Forman and Lippert, 2005; Zhang and Dhaliwal, 2009). It is possible that customers will actually reject or fail to use new technologies for various reasons (Lanzolla and Suarez, 2012). Adopting a technology requires that the customer perceives it as useful and easy to use and intends to use it in the future (Forman and Lippert, 2005; Hernandez et al., 2009).

Several important factors affect the wide adoption of the IoT in particular. In general, IoT literature mainly focuses on technical issues and requirements for adopting IoT technologies and gives little attention to business issues (Riggins and Wamba, 2015). Forming an IoT ecosystem, which includes common or dominant standards, platforms, and interfaces, is the main factor identified in the literature to enhance the growth of IoT adoption (Mazhelis et al., 2012; Miorandi et al., 2012; Belli et al., 2015). Other requirements for the wide adoption of the technology are security and privacy mechanisms (Babar et al., 2010; Miorandi et al., 2012; Bekara, 2014; Lee and Lee, 2015). However, the substantial amount of data generated by the connected machines creates challenges for IoT-adopting companies, including data management and data mining (Lee and Lee, 2015).

While most prior studies on the IoT have focused on the technical aspects of IoT adoption, and RMS literature has specifically addressed the advances in technologies and their effects on

improving the quality of life and industries, they have not dealt with the issue of creating business value in the manufacturing firm's customer relationships. For example, Kowalkowski's study (2008) focuses on the use of ICT to standardise service production and reports various productivity gains, but does not cover RMS. This paper highlights the relationship between manufacturers and customers and seeks opportunities for manufacturers to improve their business through RMS. Manufacturers use different channels to collect customer information and enhance their service business, which presents the manufacturers with various benefits and challenges.

Different channels for collecting customer information in service business

An ample amount of research can be found in the marketing literature on customer information and, more specifically, customer relationship management. These studies mainly focus on the role of customer information and different strategies to maximise customer and shareholder value (e.g., Ulaga and Chacour, 2001; Payne and Frow, 2005). Particularly relevant to this study is the role of customer information in service development.

One of the key elements for developing services is interacting with customers (Gallouj and Weinstein, 1997; Kandampully, 2002; Hipp and Grupp, 2005). This interaction helps companies obtain the latest information on their customer's needs and expectations, and the changes therein (Kandampully, 2002). Fulfilling the customers' specific needs and increasing customer satisfaction require consideration of the customers' viewpoints to develop customised offerings (He et al., 2014).

Gebauer et al. (2005) argue that receiving inclusive information on the customers' needs requires a market-oriented approach that includes wide-ranging market research, conducting workshops with selected customers, and building a network of sales, technical staff and external experts who systematically collect and record current and future customer needs. This approach concentrates on understanding the customers' expressed needs. To understand the unexpressed needs of customers, the literature on market-oriented businesses suggests observing how customers use the products or services in their normal routines and working closely with lead users (Slater, 2001). The customers' requirements can be better understood in their own natural setting than in an artificial setting (Nambisan, 2002).

In spite of all benefits gained through these approaches, they do not provide a continuous exchange of information between the manufacturing firm and the customer. The customers' locations, their motivations for participating in the service-development process, and the

validity of the provided information, among others, are issues for using some additional means to collect information from customers in service development (Bitner et al., 1997; Slater, 2001; Matthing et al., 2004). Enhanced technology solutions can assist manufacturing firms with collecting data from the customers' sites. New technologies can improve the connectivity between customers and firms and involve customers in the development of new solutions (Nambisan, 2002). In addition, closer cooperation between manufacturing firms and customers through ICT enables manufacturing firms to provide more extensive offerings (Kowalkowski and Brehmer, 2008). Since the role of new ICTs in collecting customer information and creating business value has not been studied thoroughly thus far, this paper focuses on the IoT, and particularly RMS as a widely used solution for customer information collection in service business.

Methodology

Research design

This research is a qualitative multiple case study. A qualitative case-based research design was chosen as the business aspects of RMS in industrial services have not yet been well developed (Eisenhardt, 1989; Strauss and Corbin, 1998). The research goals had an explorative character, with the intention of understanding the experiences and opinions of people in their real-life context (Yin, 2003). To better identify the various opportunities of technology-enhanced solutions for manufacturing firms, a multiple case study approach was implemented (Yin, 2003). This provided an opportunity to re-address the research scope and acquire complementary data during the research (Beach et al., 2001; Voss et al., 2002). This research design also provided opportunities to reveal the variety of approaches to customer information and utilising RMS in service business.

Six B2B engineering companies were selected as targets of the study as part of a broader research project. The cases were selected within the same industrial domain to enable sufficient depth of analysis and replication of findings (Eisenhardt, 1989), in the application of RMS and creating business value through RMS. Currently, B2B engineering firms globally are in the process of implementing IoT solutions and enhancing their service business, and the firms we selected are examples of this trend. The companies were selected on the basis of their voluntary interest in the topic, as well as them representing somewhat different markets, customers and offerings, which implies that the companies are not competing with each other. All six

companies operate in a global market, and design, sell and deliver complex technology-based solutions, and each considers servitisation a relevant strategic option for expanding their business. The companies provide various technical and support services for their installed base and have begun developing and utilising technology-based solutions in their deliveries. Fictional names – Company A, Company B, Company C, Company D, Company E, and Company F – have been used to maintain anonymity. Table 1 presents the background information of the case companies.

Table 1. Background information of the case companies.

	Company A	**Company B**	**Company C**	**Company D**	**Company E**	**Company F**
Net sales (million Euros)	<100	>1000	<100	<100	>1000	>1000
Employees	<1000	>10 000	<1000	<1000	>1000	>1000
Service share of net sales, %	30%	40%	20%	30%	51%	17%

All six companies are global equipment and component manufacturers and deliver their solutions through projects or transactional deliveries. The products include machines for mining, electricity, waste management, paper and plywood industry, and automation systems for factories. Their customers are manufacturing firms that use the equipment and components in their own manufacturing processes. Companies A, C and D provide certain products in different versions which are complemented by various specific services. These companies have narrow but global markets. Companies B, E and F have multiple business units and provide multiple product families and various services to their broad global markets.

Data collection

The main sources of data were semi-structured interviews and public documents. The study followed a managerial perspective and relied on interviews with managers involved in service delivery and development as the primary source of data. The main themes of the interviews included interviewees' perceptions of the importance of service business (types of services, current share of services, future plans), the service design and delivery process (process of service design and delivery, standardised and customised services), identifying customers' needs and expectations (existing channels, accuracy of information, role of customers, new possibilities), the role of RMS in the service business (knowledge about RMS, value drivers for companies and customers, risks and barriers), and possibilities for utilising remote data

(applications, requirements, possibilities). Table 2 summarises key information from the interviews.

In total, 16 respondents were interviewed. Most of the interviews were held individually, but on three occasions, the interview was held in pairs or a small group. In two companies (D and E), only the contact person was interviewed, and these interviews are included in the findings as they were the most knowledgeable key informants concerning RMS and servitisation in those firms. The interviews ranged from 45 to 90 minutes, with an average of approximately 60 minutes. Most interviews were performed on site, which enabled the researcher to become familiar with the interviewees' working environment at the factory. This also presented the opportunity to observe the documents of the service processes, development plans and service people who were providing remote services. The interviews were audio recorded and transcribed. After the analysis, the interview findings were discussed in a workshop with participants, including interviewees and additional people from all six companies, to validate the findings and compare them to prior studies.

Table 2. Interview data.

	Company A	**Company B**	**Company C**	**Company D**	**Company E**	**Company F**
Number of interviews	3	3	1	1	1	2
Respondents	CEO, Technology director, Service managers N=4	Field services director, Product manager, Research and development manager N=3	General service managers, Life cycle services manager, Product manager N=4	Technology manager N=1	Product manager and Project manager of new service systems N=1	Service product manager, product manager, global service project manager N=3
Average duration, min	45	45	80	45	60	90

The secondary sources of data were the companies' public documents. Related websites pages, brochures and annual reports were studied to locate relevant information for the research topic, such as different types of services, position of services in the companies' offerings, advertising and sharing information about RMS. These sources were used to collect background information on the companies and collect supporting material to design and improve the interview outline.

Data analysis and validation

An external service provider transcribed all recorded interviews. The authors reviewed all transcriptions to identify and correct any mistakes or gaps. The level of analysis is the company, and the unit of analysis is the company's approach to using customer information and RMS. The data analysis included four steps. First, the interview transcriptions were coded on the basis of the interview outline manually. Second, case-specific stories were developed on the basis of the collected data. Third, a cross-case analysis was performed to identify similarities and differences between the case companies. At this stage, the focus of analysis was on the different approaches of using customer information, as well as experiences of business value from using data from RMS, which is in line with the research questions. Finally, the cross-case analyses were contrasted with previous literature to highlight the key phenomena emerging from the interviewees' experiences. Excerpts from the interviews are used in the Findings section to highlight the main issues.

Data validation consisted of three steps. First, the case-specific findings were reviewed and validated by the representative from each company. Some parts of the report were modified based on the companies' feedback; however, these modifications concerned confidentiality issues and did not reduce the accuracy of the data. Second, a workshop was held to validate the findings and to enable a cross-case comparison. The findings of each research subtheme were presented in the workshop and discussed among the participants, which helped the authors ensure that the findings were not solely based on individual perceptions, and that they matched company-level experiences. Third, the case-specific and cross-case analyses of the findings were sent to the companies for possible final modifications. No modifications were requested at this stage.

Findings

Business value of using data collected through RMS

The researchers explored how the companies used data collected through RMS to create business value when promoting the adoption of IoT technology. The interviewees in the case companies expressed data utilisation as a key requirement to enhance the adoption and deployment of RMS. An important concern in using RMS is how manufacturers can utilise the substantial amount of data collected through the system. The managers of the studied companies frequently stated in the interviews that they need to provide some value-added solutions to their

customers and their own organisations to be able to create business through RMS. A service manager in company A stated, *"At the moment, the customers think that it is nice to receive information through RMS, but there is no difference that the information comes from RMS or traditional methods like physical inspections."* This "nice-to-have" attitude to RMS can be changed if the companies can show the business value of their system.

According to the interviewees' experiences, the collected data can be used to improve preventive maintenance. Companies can predict any probable breakdowns and attempt to solve problems in a timely manner on the basis of the alarms received from the installed base of equipment and by analysing trends for different attributes of the machines. The service product manager in Company F gave an example: *"We can tell the customer that this pump usually lasts for 4,000 hours and now you have run it for 3,500 hours; so, you should change it as soon as possible to prevent any breakdowns."*

By collecting data from many processes and pieces of equipment located at different sites, the manufacturer creates a valuable database. Meanwhile, by conducting an appropriate analysis on the collected data, the companies can identify similar problems in their machinery and use this as input for their product development programs. One of the companies has already begun using the collected data to upgrade a specific product. The lifecycle services manager in Company C explained, *"We are developing a new version and new generation of that product, and the collected data was helpful in this case."* However, he continues, *"But it is not a daily task that we are doing at our company."*

All case companies provide customised solutions to their customers. They tailor their projects on the basis of the specific needs of the customers. The global service project manager in Company F explained, *"We have different industrial segments, safety needs, environments, customers' needs and process needs. Thus, the demands are so different and the solutions are different."* The interviewees in the case companies see the opportunity to provide customised services by using increased knowledge regarding the customers' operations and performance via RMS. A service manager in Company C explained:

> *"We could see how the systems are run by the customers because they are running the systems in different ways. We could see which features they are using or utilising and which features they are not using. That*

> *might give us a better picture to know where to concentrate or what to do in the future."*

Frequent remote access to the installed base can also help the case companies evaluate how the machines are supposed to run and how customers are running the machines. Therefore, they can provide customised training for the customers to improve equipment performance. The product manager in Company E explained, *"We can inform them that if you change that parameter to less or more, it will affect the end product by this amount."* It is also helpful for evaluating a situation whereby a customer requests a refund due to an unexpected breakdown in the machinery. The product manager in Company E continued, *"So we can go to the logbook and have more accurate data and – if it is relevant – we can explain that you did not check your oil temperature or you were running with too much load."*

Organising the collected data properly and selling it as reference data to the customers represents another possible use of the collected data, thereby enabling customers to compare their performance to competitors. The technology director for Company A put it in the following words: *"We can tell them anonymously that these are your competitors and this is your level compared to your competitors and there is potential for improvement."* Another identified opportunity in this field is using the collected data in sales and marketing to calculate the benefits of new versions of products. The company can figure out the downtime of equipment due to some specific problems and can calculate the cost of the downtime for customers. This kind of report supports companies' justifications for new offerings in their sales plans. The product manager for Company B explained the situation in the following manner:

> "*It gives you the appropriate tool for marketing because in this industry, you always need something to show in statistics or based on real data. That is basically the only thing which can really sell it. Otherwise, they feel like it's nice to have it, but they do not buy it or they do not pay a good price for it."*

Table 3 summarises the core issues through which RMS were identified as a source of business value, according to the interviewees' experiences.

Various approaches to collect customer information

The case companies use different ways to identify customers' needs and expectations. Utilising advanced ICT has drawn considerable attention in all six case companies. The main technology-

based solution that can be utilised in the case companies to collect customer data is RMS. The interviewees saw the opportunity of increasing their knowledge regarding their customers' operations via RMS. The technology director in Company A said, *"RMS can help us to understand the customer's operation. By understanding what is going on there, we are able to provide the right service at the right time."* The data collected through RMS can also help manufacturing firms to obtain deeper knowledge regarding their own products in different situations. The product manager in Company E explained, *"It can be a valuable tool to understand how the machines are operating in different market areas and different climates."* Therefore, it enables firms to provide customised solutions for the specific characteristics of the customers in their unique contexts.

Table 3. Means to create value from RMS in the manufacturing firm's business processes.

Value-creating business process	**Role of RMS**	**Benefit for business value**
Customer relationship management	Data collection on equipment, its use and different user profiles	Enables timely or preventive maintenance and early identification or even foresight of problems; thereby can reduce costs and equipment downtime.
Marketing	Data collection on equipment performance	Enables calculation of financial effects of problems in equipment use, and benefit of the remote services, and calculating the value proposition / business case for the customer.
Product development and customization	Continuous monitoring of equipment status, use, problems, and performance	Enables increased understanding on the customers' operations and performance, design of better customized solutions, and targeting of the right solutions to the right customers.
Performance improvement and after-sales service	Evaluating the equipment use and comparing to specification	Enables offering solutions for performance improvement and avoiding faults and breakdowns.
New business development	Organizing the data and summarizing at the level of customer segment or area	Enables creation and selling of reference data; enables customer to compare with "best in class" or a reference market; enables offering targeted new services depending on equipment use patterns.

Using advanced technology is a relatively new way of collecting information for the case companies, which became apparent through the interviews. They have established and used other channels to identify customers' needs and expectations in previous years and continue to use them in parallel with RMS. Close customer relationships and deep knowledge of their industry and technology have been the case companies' main approaches to using customer

information. The CEO of Company A stated, *"We are talking with the customers on the management level, operator level and anything in between."* Feedback from sales people and customer relationship management systems are among the possible channels for some case companies to identify customers' expectations. The research and development manager in Company B stated, *"Sales people who meet the customers receive feedback from them and save it in a [information technology] platform to be available for future analysis."* The main challenge of these relationship-based approaches is that they are usually effective for customers who already have an established, long-term relationship with the firms and trust in them. However, occasionally it does not provide a real picture of the customers' expectations. The field services director in Company B explained:

> *"Sometimes, we are offering too much to the customers. That means the price tag is too high, so the customer asks the same solution from our competitor with a lower price. On the opposite side, sometimes we do not know what to offer."*

Holding customer focus groups and workshops were clearly less frequently used among the case companies, but for some companies, they provided an opportunity to discuss different topics directly with certain customers. The global service project manager in Company F demonstrated this by stating, *"We have different sessions where we give the customers the chance to talk about everything and, especially, their needs and expectations."* However, these approaches are more effective for analysing specific issues with those customers who already have more experience, knowledge and understanding of the topics under discussion. According to the interviewees, inspections at the customer's site were considered an effective method for observing the customer's business and identifying potential needs and opportunities.

According to the interviewees, RMS have reduced the need for physical inspections at the customers' sites, provided continuous or more frequent connections with the equipment, and, consequently, resulted in a substantial amount of data with less cost than if the data were collected manually. Most customers play a limited and passive role in the development of new solutions, based on the data. With the exception of some more advanced customers, a large majority are not active and only benefit from the developed solutions if the manufacturing firms first envision the customer's needs and offer them proactively. This is mainly due to the complexity of the products and solutions. The product manager in Company F confirmed, *"You have to always wake them up. You have to ask the right question and guide the customer a little*

bit." Thus, the latent needs of customers are not necessarily expressed by customers through relationship-based approaches.

Discussion

Business value of RMS for manufacturing firms

The study has taken a step towards better understanding the business changes enabled by IoT adoption and the use of RMS in manufacturing firms' customer relationships. The first research question asked how managers in manufacturing firms perceive the business value of RMS in industrial service business. RMS and the IoT, in general, hold high hopes for positive changes in industries, but RMS have previously been considered primarily as technology enablers, and manufacturing firms and their customers adopt technologies slowly and cautiously.

Where previous research on IoT adoption has focused on common/dominant standards, platforms and interfaces (Mazhelis et al., 2012), and security and privacy mechanisms (Miorandi et al., 2012), this paper has discussed creating business value through RMS as a need-to-have driver for adopting the technology. The findings have indicated that changing the mindset towards RMS is one of the key concerns of the manufacturing firms that provide complex systems to their customers. Basic RMS-enabled services, such as assessing spare parts needs and calculating machine hours, are not sufficient; manufacturing firms need to learn ways to provide more advanced business value to convince customers to accept and even pay for the services.

RMS and IoT technologies open up new kinds of service domains for manufacturing firms offering industrial services. Most previous studies on RMS have focused on maintenance as the main application of RMS (e.g., Nieva, 1999; Biehl et al., 2004; Jonsson et al., 2008, 2009; Mori et al., 2008; Brax and Jonsson, 2009; Westergren, 2011; Westergren and Holmström, 2012). In addition to improvements in maintenance and spare parts delivery, the researchers argue that RMS can be effective in other types of services, such as inspections, modernisation, extensions, and training. To convince customers that RMS are a necessary part of service business, manufacturing firms should show that continuous technology-based customer interactions can supplement the benefits of periodic and scheduled customer interactions. The interviewees emphasised the current and potential benefits of RMS regarding interaction continuity and customer closeness, as well as providing specific services based on the customers' requirements at the right time.

The role of RMS has earlier been covered primarily in the after-sales phase. Previous studies on RMS have focused on the benefits for manufacturing firms and, particularly, for customers from condition monitoring (Nieva, 1999; Mori et al., 2008), and the value creation process by improving maintenance (Jonsson et al., 2008). However, condition monitoring and improved maintenance are the direct payoffs from the technology; the impacts on other critical business activities also form a significant part of the perceived value of RMS. This study contributes to industrial service research by showing the ways in which RMS enable business value in various business processes more broadly: customer relationship management, marketing, product development and customisation, performance improvement and after-sales service, and new business development. Efficient data utilisation is needed, and the case companies put their efforts into analysing the collected data from different locations, providing analytical reports, and assessing trends to create customer value and capture business value. This study suggests that manufacturers cannot succeed in increasing the adoption of RMS by focusing on technical enablers only; they should utilise the potential capabilities of RMS in their business processes more broadly to increase customer knowledge and knowledge of product use, and convert the substantial amount of collected data into business value.

Improving customer data collection through RMS

In the second research question, we inquired how RMS along with other data collection channels help manufacturing firms to identify customers' needs and expectations. The findings show that the case companies use multiple ways to acquire knowledge about their customers' needs and expectations. Predominantly, all six case companies mostly depended on their relationship-based methods for customer information collection at all levels of their organisations. The importance of direct customer participation and maintaining conversations with customers to develop new ideas has been highlighted in the literature (Alam, 2002; Nambisan, 2002). The findings of this study, lending support to previous research (Bitner et al., 1997; Slater, 2001; Nambisan, 2002; Matthing et al., 2004), not only confirm the benefits of these methods but indicate some issues that may decrease the efficiency of relationship-based customer information channels in manufacturing firms: customer's limited product knowledge; long distances between manufacturing firms and customers; and the validity and quality of the customers' data. The case firms see advanced ICT as a valuable tool to overcome these issues and bring new insights to the firms.

The first issue reducing the efficiency of relationship-based customer information use deals with the customers' knowledge. The advanced equipment offerings of manufacturing firms are

complex, and considerable knowledge is embedded in their technologies. Market-oriented firms have traditionally used focus groups, surveys and close relationships with customers to increase their understanding of customers' needs and wants, but these approaches are mainly dependent on the expressed needs of customers (Slater, 2001; Matthing et al., 2004). In the case firms, RMS were experienced as enablers for continuous connections between the manufacturing firms and the customers' sites, and for pointing out bottlenecks, equipment misuse, and other important factors in the production process, and consequently, to understand the technical needs that are not explicitly expressed by the customers.

Second, globalisation and providing equipment to customers in different locations add to the challenge of collecting information from customers in a cost-effective manner (Nambisan, 2002). This implies that companies cannot use the old-fashioned way of collecting information, which requires direct physical contact between the manufacturing firms and customers. One of the main benefits of RMS identified in this study is reducing the need for site visits, since the manufacturing firm's technicians can monitor their installed base of equipment remotely through RMS. This can have positive implications on service costs, in terms of reducing the need for on-site service resourcing and traveling.

Third, one of the main obstacles of relationship-based approaches to customer information collection is the validity and quality of the data provided by the customers (Bitner et al., 1997). This issue is mainly due to the customers' lack of knowledge regarding the product, motives of customers' employees, and limited experience with the product. In the identified customer information collection methods in previous studies, such as face-to-face interviews, user visits and meetings, users' observations and feedback, and focus group discussions (Alam, 2002), manufacturing firms assume a more passive role in collecting customer information, implying that they are more dependent on the information provided by the customers. The findings of this study show that while the information provided by the customers is helpful for manufacturing firms in identifying service needs and requirements, the information may not be relevant, accurate or valid for the manufacturing firm's exact use, such as defining service scope, i.e. which services for which equipment, timing, and alignment with, for example, other customers. Therefore, they need to have other channels for collecting and validating relevant data. This kind of proactive information access enables avoiding the validity concerns stemming from second-hand data.

This study contributes to previous research in service business regarding the role of customers and customer information within service development by emphasising the necessity of using multiple ways for collecting customer information to have a clear picture of the customers' current and future needs. Advanced technologies such as RMS cannot be isolated from other customer information channels. The manufacturing firms need to strike a balance between automation resulting from advanced technologies and the quality and value of services for the customers (Kowalkowski and Brehmer, 2008). Relationship-based processes are necessary not only for collecting data but also to enhance customer relationship management. Superior technical knowledge of service developers can limit their ability to provide original ideas and, thus, customers or users can be considered inspirers of new services (Magnusson, 2003). However, the interviewees admitted that occasionally they are unable to make the right assumptions about their customers' needs and expectations by using these traditional methods. The respondents discussed accessing equipment on dispersed sites simultaneously to analyse a problem based on real-time data. Thus, advanced technologies must be increasingly integrated into information collection processes of manufacturing firms to find the unexpressed needs of customers, decrease data collection costs, and increase the validity and quality of the collected data.

Conclusion

Research implications

This study contributes by offering new knowledge on the creation of business value through the use of IoT-based technologies such as RMS in industrial service business. The empirical findings in six engineering firms have led to a better understanding of the value added by RMS in different business processes. Most prior studies on RMS have focused on preventive maintenance as the main application area, which always occurs in the after-sales phase. This study highlights possible broader applications of RMS in a manufacturing firm's business, in customer relationship management, marketing, product and service development, and the customisation process. The findings highlight the potential for creating business value from the substantial amount of data collected through RMS. As RMS and IoT-related technologies are adopted, they can be used to complement other customer information collection channels and, thereby, improve the efficiency of services through improved knowledge access, removal of physical distances, and better validity and quality of data.

Managerial implications

This study draws attention to IoT adoption and the role of different data collection channels in manufacturing firms' service business. Although the technological enablers of the IoT are largely available to manufacturing firms, we have shown that adopting RMS specifically and the IoT more generally contains various business-related factors that can enable or restrain the use of technologies in service business. The business aspects of RMS need to be considered in firms to achieve the benefits of the IoT in a full-scale service business. The findings have shown that RMS can be a useful channel for collecting and using customer information efficiently and, thereby, developing and delivering new services. Managers need to enhance the use of customer information in service design and delivery, and the effective use of RMS-based customer information will require new routines and processes. Converting the collected data into suitable formats, integrating multiple data sources, and analysing them are critical areas that need to be covered effectively in the service business. Manufacturing firms also need to understand how RMS will change their customer relationships. In an automated supplier-customer cooperative setting, manufacturers need to become more open to the different ways of doing business with customers. Depending on how they utilise RMS in their operations, it may change the companies' business models.

Limitations and future research direction

The study was conducted in six companies in the engineering industries, which limits the generalisability of the findings to similar contexts. Further, the number of interviewees was rather limited in each case company. To improve the validity, informants were selected based on their first-hand experience in the use of RMS; thus, they were expected to offer topical and accurate knowledge on the issues in their firms. Reviews and workshops with company representatives were included to validate the findings both at the company level and across companies. The interviews were mostly conducted with managers in product development and service units, and the experiences and opinions of service design and delivery employees and supporting business functions, such as sales and marketing units, remain topics for future study.

This study has presented some possible uses of RMS as one of the relevant technologies in the IoT. The IoT encompasses other technologies such as RFID and M2M communication. Further studies are needed to analyse the potential of these technologies for use in manufacturing firms and to evaluate their possible effects on service business, product development, and operations. Also, the findings showed that manufacturing firms use multiple channels for customer

information collection. It would be interesting to study the multi-channel customer information approaches and platforms further to identify their success factors and contextual alignment across different types of companies.

The present research focused on one core aspect of IoT technologies, i.e. data utilisation. Other related topics that can affect data utilisation, such as data security, were not covered. Different aspects of data security and possible approaches to eliminate or mitigate these risks must be explored in the future.

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PUBLICATION II

Allocating human resources to projects and services in dynamic project environments

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Allocating human resources to projects and services in dynamic project environments

Khadijeh Momeni and Miia Martinsuo

Tampere University of Technology, Tampere, Finland

Abstract

Purpose – Resource allocation is challenged by dynamic environments where changes are frequent. The purpose of the study is to identify resource allocation challenges and practices in service units that perform both project and non-project activities in dynamic environments. Its goal is to show that top-down mechanisms of project resource allocation need to be replaced by or supplemented with mechanisms that are more flexible.

Design/methodology/approach – A qualitative comparative case study was conducted in two service units of two project-based firms. The main source of data consisted of semi-structured interviews with 17 service managers and staff members.

Findings – This study shows that resource allocation is not necessarily a top-down process at all, and the practices are context-dependent. Two more flexible approaches are revealed – hybrid resource allocation and bottom-up resource allocation – as examples of managing resource allocation in service units that engage in projects under uncertain conditions. The results of the analysis highlight prioritisation and adapting to change and delay as the main issues that managers face in allocating resources to different types of projects and service activities in dynamic environments.

Research limitations/implications – The two target companies chosen for the qualitative research design limit the analysis to project-based firms in a business-to-business context. Further, the viewpoint of the service unit is central to the study. Studying project resource allocation in different organisational contexts and uncovering the perspectives of product development and delivery units would offer promising directions for future research.

Practical implications – The study reveals that in dynamic project settings such as service organisations, top-down mechanisms of resource allocation need to be accompanied by other, more flexible approaches to ensure the sufficient resourcing of projects and related services in dynamic environments. Companies need to establish practices for resource allocation changes that are caused by re-prioritising tasks and accommodating changes and delays in their project and service activities.

Originality/value – Compared to a top-down perspective taken in previous research, the study proposes a more flexible approach for resource allocation in constantly changing environments with different project and service activities. Previous studies have focused on resource competition between projects, placing project managers in the central role for resource allocation. By contrast, this study discusses hybrid and bottom-up resource allocation, both of which involve broader personnel engagement in resource allocation tasks, drawing on the experience of all employees.

Keywords project-based firms, resource allocation, uncertainty, activities, services, contingency view

Paper type Research paper

1. Introduction

The increased use of projects in various industries has resulted in changes to organisational structures and a move from functional line organisations to more flexible project-based forms of organisation. Human resource allocation becomes critical for project-based firms when the same resources can be assigned to several overlapping projects as well as non-project activities. Resource allocation is more challenging for organisations that face rapid changes in their environment, activities and priorities. In an uncertain organisational context, using the same resource pool to carry out projects and non-project activities poses difficulties for resource allocation. Such challenges are not yet sufficiently understood, and their solutions have not been sufficiently explored. This study investigates how human resources can be allocated to projects and other services under dynamic conditions.

This study responds to the need for understanding the situated practice of resource allocation and the related contextual and contingency variables in project-based firms (Söderlund, 2004). Previous project management studies building on contingency theory have included some aspects of the project and organisational context in their analysis, such as different types of complexity (Baccarini, 1996), technology (Shenhar, 2001), project autonomy (Martinsuo and Lehtonen, 2009), and management control (Canonico and Söderlund, 2010). The majority of such research has investigated construction and product development projects, and the focus has been on selected processes in project management: contracting, decision making, knowledge generation/integration/exchange, project (management) evaluation, projects as business processes, relationship management and risk management (Hanisch and Wald, 2012). Different resource allocation approaches in different organisational settings have not received significant attention in project contingency research.

Previous studies of resource allocation processes within project-based firms and the challenges they face have focused mostly on the prioritisation of projects and assigning resources to multiple projects. These studies generally employ a top-down perspective regarding resource allocation and consider managers to be the responsible actors assigning tasks to staff (Hendriks et al., 1999; Abrantes and Figueiredo, 2015; Ballesteros-Pérez et al., 2012; e Silva and Costa, 2013). Earlier studies have primarily examined resource allocation in multi-project environments within organisations, such as research and development units, rather than units that face external customers directly, such as service units. Like internal units, these customer-facing units deal with internal uncertainties due to the cross-functional involvement of personnel in projects. However, they also face additional uncertainties stemming from customers and the broader market environment. Thus, new research is needed on how project-based firms facing uncertain conditions use their human resources in both projects and non-project activities.

Project-based firms generally allocate resources from a resource pool – a department or unit – to accomplish parallel projects (Zika-Viktorsson et al., 2006) and non-project activities. One of the main difficulties in assigning resources to project and non-project activities is the potential for resource conflict between the project management unit and other functional units (Kuprenas, 2003; Laslo and Goldberg, 2008), such as service units. Project-based firms benefit from complementing projects with non-project activities, such as services (Artto et al., 2008). Integrating projects with services represents a change to the traditional viewpoint on projects, extending their life cycle beyond the delivery phase (Brady et al., 2005). However, resourcing projects and services in parallel increases the complexity of resource allocation and adds non-project activities as an alternate use of the resource pool. The simultaneous existence of multiple different delivery logics can pose problems for various units of the organisation, such as service units that view their core activities from a specific functional perspective (Davies et al., 2006).

In allocating resources among projects as well as service activities, frequent changes in the customer-facing service environment pose major challenges. Uncertainty in service environments is high, and service people must respond quickly to unanticipated changes. Uncertainties in the environment can affect resource allocation plans in the project-based firm and may result in rearranging resources between project and non-project activities. Previous research on uncertainty in project-based firms shows that the availability of resources is one of the main uncertainties in multi-project environments (Danilovic and Sandkull, 2005; Arashpour et al., 2016; Martinsuo et al., 2014; Laine et al., 2016; Saunders et al., 2016) and can cause various changes in project plans. Meanwhile, other sources of uncertainties in project-based firms, such as scope changes or revisions to plans and consequent adaptation to events and the changing environment (Söderholm, 2008), can challenge the resource allocation process. Literature on project uncertainty has mainly differentiated uncertainty from risk, mapped the sources of uncertainty and developed various approaches to managing project uncertainty (Saunders et al., 2016), but does not provide insight into how to manage resource allocation under uncertainty. In a dynamic environment, an organisation needs to become more flexible in reacting to changes by choosing between alternative actions (Perminova et al., 2008). However, the dominant approach based on decisions made by managers in advance may limit the organisational flexibility required in dynamic environments (Jerbrant and Gustavsson, 2013). It is therefore crucial to understand the resource allocation issues in this type of environment and how resource allocation practices are performed.

This study concentrates on human resources that deliver projects and services within project-based firms in terms of resource planning, allocation and management. Its purpose is to explore the challenges and practices involved in allocating human resources in project-based firms in situations of uncertainty, particularly within service units. Service units are a good example of a high-uncertainty environment, where project activities and non-project activities share the

same pool of resources. The study aims to offer new knowledge to optimise resource allocation in conditions of uncertainty by identifying the practices currently used for resource allocation, and by mapping alternative approaches. Thus, the research question is as follows: *How do service units manage resource allocation to projects and services to overcome uncertainty?*

The empirical study focuses on manufacturing firms delivering complex systems as projects and supplementing their offerings with services for customers. The research was conducted as a qualitative case study in two leading international firms, both of which have a significant global installed base of equipment. Both firms' offerings range from standard equipment and project deliveries to a broad scope of services. This study contributes to the contingency-view of projects and project-based firms by identifying the resource allocation issues involved in delivering project-related services and using the same resource pool for both project and non-project activities. Furthermore, it demonstrates that possible resource allocation mechanisms are not limited to top-down mechanisms; more flexible approaches are needed to manage uncertainty. Future studies should undertake broader analyses of experiences from other units; they should also explore perspectives arising from product development and product delivery. This study does not follow a mathematical perspective to resource allocation but, rather, seeks in-depth understanding of the experiences of managers and staff in managing resource allocation.

The remaining sections of the paper provide an overview of the literature on resource allocation approaches used in project-based firms, resource allocation issues arising in project-based firms and managing resource allocation issues in dynamic environments. In the methodology section, the data collection method and analysis approach used in the two-case qualitative study is introduced. The results section summarises key findings from the two cases as well as conducting a cross-case analysis. The findings are discussed in light of earlier research, and the

final section of the paper identifies the key contributions of the study, along with the limitations of the research and suggestions for further research.

2. Literature review

2.1. Resource allocation approaches in project-based firms

Human resource allocation can be viewed as a core process in project-based firms. Resource allocation is the process of assessing resource availability and project needs in terms of specific development needs, expertise, experience working with particular customers and partners and assigning suitable resources to different tasks (Huemann et al., 2007).

Previous research generally approaches resource allocation as a top-down process using strategies to make project portfolio decisions, and resources are allocated to projects in line with strategic priorities. The literature on multi-project management is dominated by the perspectives of project portfolio managers and program managers and emphasise methods to plan and schedule resources to gain control over the project portfolio (Zika-Viktorsson et al., 2006). Hendricks et al. (1999) carried out one of the early practical studies on resource allocation in a research and development environment. Their study proposes a rough-cut-project-and-portfolio-planning approach led by senior management and project managers to connect day-to-day plans to the long-term business plan. Some studies on resource allocation in matrix organisations have highlighted the role of project managers and functional managers in making planning decisions to allocate resources to different activities (Laslo and Goldberg, 2008; Arvidsson, 2009).

While more recent research on resource allocation tries to cover new challenges and decision-making situations in project-based firms, they also continue to reflect top-down approaches where the project manager primarily plans and controls the resource allocation process. For

example, Abrantes and Figueiredo (2015) proposed a four-layer resource allocation framework for new product development portfolio, including tasks for the portfolio manager, for the project or program manager, for the team resource manager and for team members. In this elaborated framework, the project manager and the resource manager are responsible for developing project and resource plans and assigning them to the project teams. In another study on resource allocation in multiple projects, Ballesteros-Pérez et al. (2012) provided a quantitative process that enables project managers to assign staff to different work groups or projects. A study by e Silva and Costa (2013) on resource allocation in information systems projects also envisions a project environment where the project manager controls the management of human resources.

In general, the resource allocation process is often explained in previous literature as reflecting a hierarchical structure where the project manager or resource manager has the central role in allocating resources to different projects. However, the inherent uncertainty involved in projects and their environments causes challenges for project-based firms and indicates the need for closer inspection of resource allocation issues and practices.

2.2. Resource allocation issues in project-based firms

2.2.1 Resource allocation issues in multi-project organisations

Previous research on multi-project management and project offices raises the issue of resource allocation in project-based firms. Resource constraints and the improper allocation of resources are key problems facing multi-project organisations (Elonen and Artto, 2003). Project scheduling failures and over-commitment of resources are key mechanisms influencing resource demand, while deficient management accounting systems and opportunistic managers are mechanisms that have a negative influence on resource supply (Engwall and Jerbrant, 2003). Different projects in the project-based firm may have a different degree of access to resources,

and thereby, a different degree of resource autonomy, depending on their position in the parent organisation and in the broader stakeholder network (Martinsuo and Lehtonen, 2009).

The literature on multi-project management usually focuses on competition for resources between several projects in an organisation (Fricke and Shenhar, 2000; Laslo and Goldberg, 2008; Zika-Viktorsson et al., 2006). Challenges for resource allocation include estimating resources for each project, dealing with changes to resource needs during the life cycle of a project, setting priorities among different projects and the number of interfaces between the projects and their surrounding environments (Zika-Viktorsson et al., 2006). Engwall and Jerbrant (2003) describe the issue of resource allocation as a syndrome in multi-project management. Their qualitative case study examining two engineering companies reveals that resource allocation is the primary issue in organisations that manage most of their operations as simultaneous or successive projects.

Some studies on project management offices have covered resource allocation in multi-project organisations. Project management offices may support or take responsibility for resource allocation to projects (i.e. staffing assistance, e.g. Dai and Wells, 2004; Hobbs and Aubry, 2007), or may act as resource pools from which resources can be allocated among projects. Prior research has focused on competition between projects, resource planning and resource allocation responsibilities in multi-project organisations, with a specific focus on interactions between projects. However, the challenge of resource allocation in project-based firms is not limited to projects alone, but also includes other types of activities competing for the same resources.

2.2.2 Resource allocation issues between temporary and permanent organisations

In contrast to the traditional approach to project management, more recent approaches highlight the interrelationships between projects, organisations and individuals. These interdependencies

force projects to compete for resources. In their paper elaborating on Lundin and Söderholm's (1995) temporary organisation theory, Jacobsson et al. (2013) highlight the links between temporary and permanent organisations and challenge the contrast between these two forms of organising. Communication problems, conflicts with existing units, difficulty in accessing complementary resources and opportunities to collaborate in the use phase of systems are examples of reasons to interlink temporary and permanent organisations (Jacobsson et al., 2013).

One of the main challenges occurring at the interface of temporary and permanent organisations is allocating resources to projects. Project teams depend on the context of permanent organisations (Lundin and Söderholm, 1995) and face different degrees of autonomy and control in relation to the parent organisation (Martinsuo and Lehtonen, 2009). This means that most of the personnel needed for a project must be borrowed from functional departments, which requires negotiation between project managers and functional department managers, as well as among the personnel themselves (Jacobsson et al., 2013; Turner and Muller, 2003). Collaboration between different departments requires suitable communication skills that differ from those needed to communicate within units (Midler, 1995). The relationship among individuals, and between the team and the environment, are to be managed through building commitment between individuals and legitimate relationships between the team and its environment (Lundin and Söderholm, 1995). Allocating resources between different types of activities is not straightforward, and studies of matrix organisations have revealed that resource conflicts and confusion over roles and responsibilities are possible between projects and functional line activities (Kuprenas, 2003; Laslo and Goldberg, 2008). The tensions related to access to critical resources is one of the main issues that arise in projectified matrix organisations (Arvidsson, 2009). Although the literature has acknowledged the resource

allocation issue in principle, practical resource allocation issues at a firm level have not been sufficiently covered.

2.3. Managing resource allocation issues in a dynamic environment

Dynamism represents the extent to which projects are influenced by changes in the environment (Collyer and Warren, 2009). Dynamism in a project environment is not limited to complex technology projects, and it can represent a threat to projects across all industries (Collyer et al., 2010). Collyer and Warren's (2009) and Collyer et al.'s (2010) studies are among the few that explicitly focus on dynamic project-based environments. They identify the possible causes of changes in the environment, document the challenges posed by project dynamism, and explore various management approaches to deal with dynamic environments more effectively. Difficulty in finding and managing skilled labour is one of the challenges created by higher levels of change in a dynamic environment. In fact, since different events could occur in the environment, long-term planning can waste time and resources (Collyer and Warren, 2009).

Unanticipated changes may result in re-shuffling resources in a firm and may prompt project managers to go beyond their plans to use resources in new ways (Söderholm, 2008). Previous studies have seen the availability of resources and sharing resources between different projects and functional departments as a major challenge for resource allocation (Danilovic and Sandkull, 2005; Arashpour et al., 2016; Laine et al., 2016; Saunders et al., 2016). Uncertainty management issues of resource allocation include adequate accuracy of resource estimates, estimating resources required, defining responsibilities, defining contractual terms and conditions and selecting capable participants (Atkinson et al., 2006). Organisational or structural complexity has been recognised as the main cause of resourcing uncertainties and challenges (Martinsuo et al., 2014; Maylor and Turner, 2017). Managers usually use planned responses to deal with structural complexities (Liu and Leitner, 2012). Therefore, it has been a

common argument that firms that have good systems for allocating resources efficiently, among other required systems, are more successful in managing risk and uncertainty (Kardes et al., 2013). However, different risks and uncertainties can change the effectiveness of the control mode in project-based firms (Liu, 2015). Organisations face also various emergent complexities (besides structural complexities) that include uncertainties and dynamics in the project environment and need more flexible responses (Maylor and Turner, 2017). Jerbrant and Gustavsson's (2013) research on managing project portfolios showed that the constant change of plans and constant shifts between projects and activities in the project-based firm forced project managers not to plan ahead but also to improvise when situations change.

Altogether, resource allocation is a source of uncertainty and can also be influenced by uncertainties in a dynamic project environment. The project uncertainty management literature has mainly explored uncertainty from within a single project, and fewer studies have taken a broader approach toward uncertainty management at the level of the project-based firm. Construction and product development projects have been the dominant project types in previous research. Previous studies have analysed the different types of uncertainties, e.g.: sources of uncertainties (Söderholm, 2008; Atkinson et al., 2006); experiences of environmental uncertainties especially in the construction industry (Arashpour et al., 2016); different sources of uncertainties in R&D project portfolio (Martinsuo et al., 2014); and uncertainties associated with the project network (Atkinson et al., 2006). Also, uncertainty management is increasingly studied, e.g. in terms of: ways of managing uncertainties in safety-critical projects (Saunders et al., 2016); different approaches to managing project uncertainty (Atkinson et al., 2006; Perminova et al., 2008); risk management for megaprojects (Kardes et al., 2013); collective sense-making in overcoming uncertainties in R&D programs (Laine et al., 2016); and interdependencies and relations in managing product development projects (Danilovic and Sandkull, 2005).

Despite this active research in uncertainties and their management, the earlier studies have not directly investigated resource allocation in dynamic environments. In dynamic environments, multi-project and non-project activities challenge the traditional top-down view of resource allocation. It is therefore crucial to understand the challenges facing resource allocation in an environment with high uncertainty, particularly in settings where project and non-project activities may compete for the same resources, and to explore different approaches to managing resource allocation.

3. Research methodology

3.1. Research design

This research took the form of a qualitative comparative case study, a method seen to be suitable for understanding the experiences and opinions of people in their real-life contexts (Yin, 2003), enabling an in-depth analysis of a relevant and not yet well-known phenomenon (Yin, 2009). We sought for cases that would be informative concerning resource allocation in dynamic environments delivering both projects and services. Since the number of cases that can be studied in any research project is limited, it is not preferable to choose cases randomly (Eisenhardt, 1989), but rather it is important to select cases where relevant data could be gathered. Therefore, two companies were sought in a similar kind of context that would represent diverse resource allocation practices. The companies were approached to describe the processes of planning and managing resources in one of their customer facing units, along with the effects of other units on its resource allocation decisions.

The study was carried out in two service units that are part of two project-based firms, an industrial equipment and service provider (Company A) and a technology systems provider (Company B). Both companies have a similar background: they design, sell and deliver

complex technology-based solutions in global markets. The companies represent typical system suppliers that deliver their systems as projects with other industrial firms as clients, carry out such projects repeatedly on a large scale, and complement their systems with services. Service business has increased in importance for both companies. Thus, both units represent good examples of project delivery supplemented with industrial service delivery.

Service units were chosen purposefully for analysis: service units in project-based firms contribute to both projects and service activities which thus compete for the same resources. Furthermore, service units are good example of an organisational context that changes rapidly and faces different sources of uncertainty, from within the organisation as well as from the customer and business environment. Staff in service units are usually allocated to the core projects of the company (equipment design, manufacturing and delivery projects), service projects (e.g. modernisation) and routine activities (e.g. maintenance).

Comparison of the two service units based on three dimensions of complexity, as explained in Maylor and Turner (2017), shows that the service units do not face considerable socio-political complexity. Structural complexity in Company B is higher than Company A, mainly due to the higher number of people involved, higher number of interdependencies across the different disciplines of the service unit and with the core projects of the company, broader variety of work, and higher number of disciplines involved in core project related activities and service projects. Company B also performs in a more dynamic environment in terms of emergent complexity. The novelty of the service projects in Company B is higher and the service people receive more emergency requests from the customers. Table 1 presents the background information of the case companies. The companies use different resource allocation methods in their service units. The differences between the level of complexity and resource allocation

practices make these two cases as excellent examples to study resource allocation practices in a dynamic environment.

Table 1. Background information of the case companies

	Company A	**Company B**
Net sales (millions of euros)	>1,000	>1,000
Employees	>1,000	>1,000
Service share of net sales (%)	51%	17%
Portfolio of projects	Similar projects in a specific industry	Various projects in varying industries
Type of projects	Medium complexity	Fairly high complexity

3.2. Data collection

The main source of data consists of semi-structured interviews with 17 respondents, lasting an average of 82 minutes. The interviewees were selected by consulting with a contact person in each company to identify the most knowledgeable people in the organisation concerning resource allocation processes. Many of those interviewed were experienced service managers and staff, who were able to provide detailed knowledge about resource allocation and relate their experiences of uncertainties in their daily work. Table 2 summarises key information about the interviews and interviewees.

Table 2. Interview data

	Company A	**Company B**
Number of interviewees	7	10
Respondents	Director of technical support, project manager of new service systems, service development staff, vice president of technology, director of sales and services, service manager	Service managers, supervisor of service managers, service staff
Average duration (min)	100	70

The interview outline was developed iteratively in collaboration with the key contacts at the selected companies. After discussing the resource allocation process and decision-making approaches with a few mangers in each company, an interview outline was developed as the basis for interviews with service mangers and staff. The main themes of the interviews included the structure of the organisation, the types of project and service activities conducted, the work environment, the resource allocation process, key participants in decision-making and links to other units. All interviews were performed on site, enabling the researchers to familiarise themselves with the work environments of interviewees and to observe how managers and staffs used the resource management systems in place within the organisation.

The companies' resource planning and monitoring systems provided secondary data sources. While Company A used a web tool to allocate and monitor human resources, Company B used a simple Excel worksheet as a resource calendar. The researchers observed both tools during the interviews.

3.3. Data analysis

An external service provider transcribed the recorded interviews. The first author reviewed all transcripts to identify and correct any mistakes or gaps. The unit of analysis was the resource allocation practice at the service unit level. The researchers were interested in analysing the challenges involved in allocating service staff to projects and service activities in a situation of uncertainty. Data analysis proceeded inductively, as no previous research offered a preliminary framework concerning resource allocation under uncertainty; this phase included four steps.

First, the transcripts were analysed to identify the different types of activities undertaken by the units, as well as their main resource allocation challenges and practices. In this phase, *the activities* in the service units were mapped to the following categories: core project-related activities, service projects, service contracts and ad hoc activities. During the analysis, these

activities were identified as differing from each other significantly in the nature and degree of uncertainty they represented. Among the four main types of activities, the analysis revealed that the uncertainties and related challenges experienced by the interviewees were mainly related to two types of activities: core project-related activities and ad hoc activities.

Second, the interview transcripts were coded on the basis of identified themes. All the challenges mentioned by the interviewees that affect resource allocation plans and decisions were labelled as *resource allocation issues*, including uncertainties in the work environment, changes in priorities, schedule changes, scope changes, and information flow among units. All the approaches, practices and processes that the interviewees mentioned that are used to manage resource allocation were labelled as *Managerial practices*, including organisational structure, roles and responsibilities of managers and staff, resource allocation practices, authority to prioritise activities, cross-functional communication and categorising resources.

Third, case-specific stories were developed on the basis of the collected data. Here, the different *resource allocation approaches* were labelled ‘hybrid’ or ‘bottom-up’ based on their unique characteristics and differences. Finally, the case-specific analyses were compared with each other and with the previous literature to highlight key phenomena. Excerpts from the interviews, cross-tabulation of the key comparisons and illustrative figures are used in Section 4 to highlight the main issues.

4. Results

4.1. Uncertainties in the environment and resource allocation issues

The service staff in both case companies are experienced in delivering project and service activities. They are involved in different projects, from simple service projects relying mainly on service staff to more complex projects that draw on versatile resources from different

departments within the firm. Table 3 shows the main activities involving service staff and their various characteristics, particularly in relation to uncertainty. While service units in both companies engage in all types of activities, the share of project-related activities and service contracts is higher in Company A. Meanwhile, Company B's service staff face more ad hoc requests and provide more urgent repair and maintenance services.

Table 3. Different types of activities in the service units, and their uncertainty characteristics

Type	Activities	Characteristics
Core project-related activities	Start-up and commissioning, product development	High uncertainty in time Different units' resources
Service projects	Upgrade, modernisation, expansion	Medium uncertainty in time and scope Mainly service unit's resources
Service contracts	Preventive maintenance	Low uncertainty in time and scope Long-term plan Only service unit's resources
Ad hoc services	Spare parts and tools delivery, repair	High uncertainty in time and scope High emergency Only service unit's resources

Both companies face similar resource allocation issues. While the service units try to deploy their human resources efficiently among both project and service activities, they have to change their schedules and resource allocation decisions frequently. A manager in Company A explained, *"When you come to the office, you never know what is going to happen during the day. That is the special characteristic*." As presented in Table 3, two types of activities contain additional uncertainties: core project-related activities and ad hoc services. These uncertainties usually come from two separate sources in the service unit environment: from the project management unit and from customers.

Activities that are related to the core projects of the companies are dependent upon project management units. Start-up and commissioning form the last phase of the companies' core project delivery and can last from one week to six months depending on the complexity of the equipment delivery. The timing of these activities depends entirely on the previous phases of the project, which are carried out by other departments. In each company, the product

management unit is mainly responsible for the entire project; start-up and commissioning are usually defined in the project plan as comprising one activity. Meanwhile, the service unit plans and manages the details of start-up and commissioning activities. A manager in Company B explained, *"When we are involved in some bigger project, our activities are presented as one activity or item [in the project schedule]."* Another manager in Company B continued, *"You have to communicate with customers, plan related activities, deliver and test. You need to look at timetables of different departments."*

In addition to these core projects, service staff are occasionally allocated to other project activities, such as new product development projects. Their role is usually limited to the final phase of development projects – they might monitor pilot projects and provide feedback for the product management unit. A manager in Company A explained, *"Our team is also involved in new product development projects and new product piloting, basically, in monitoring the prototypes. When the product management does not have the available resources or the company launches prototypes all over the world, then service people will help there*."

The resource allocation plan may change due to delays in previous phases of a project as a consequence of activities in other departments. Since service staff are involved in the final phases of core projects, their schedules and resource management decisions are affected by these previous phases, which creates uncertainties for the timing of the project-related activities. Service units therefore do not always have resources available to allocate to the project at the required time. This issue becomes more important when the core project relates to the whole production process. In this case, service staff might be involved at various stages of the project execution phase. A manager in Company A explained, *"We are in the process of starting up a plant. We have started up the primary part, but we have to wait until the rest of the operation*

is completed. Then there will be another commissioning until the whole line operates from A to Z. Thus, it is very difficult to find out what the time frame is."

Second, such ad hoc services as delivering spare parts along with repair and maintenance service form a significant part of the work of service staff. Both case companies deal with ad hoc requests from customers and are experienced in providing spare parts and maintenance services in emergency situations. The customers are usually in crisis when they ask for help from these companies, and service units must respond to their unplanned requests as soon as possible. Thus, service staff may be forced to cancel other planned activities to resolve critical issues for customers, on-site. The scope of these activities is usually uncertain, and service staff must estimate the amount of effort required after visiting the equipment or production line.

Those interviewed highlighted the fact that resources allocated during the planning phase do not always represent the actual service staff that carry out activities during the execution phase, because of ad hoc repair and maintenance activity at customers' locations. A service engineer in Company B gave an example of this: *"It does not always go according to the plan. For example, a service engineer might be at a customer's site to deliver some services, and the work takes longer than its original estimation. In that case, the service manager allocates another available engineer that has the required skills."* Service units must respond to urgent problems, which could lead to a shutdown of the customer's production line. Therefore, solving these issues has the highest priority for service staff and can impact resource allocation plans. Interviewees in Company B mentioned this issue more often than those in Company A, because they provide more unplanned services to their customers.

4.2. Resource allocation practices

Besides similar issues that both case companies face in allocating their resources, the study revealed two rather different approaches in resource allocation. Table 4 shows an overview of

these practices in the two case companies. Below, these practices are reported for each company separately.

Table 4. Overview of resource allocation practices in the two case companies

	Company A: Hybrid resource allocation process	**Company B: Bottom-up resource allocation process**
Resource allocation practice	The resource planner plans resource allocation based on the availability and technical skills of the staff. The service managers and service staff plan the workload and negotiate to solve issues.	The service staff plan their resource allocation. The service managers support them in critical situations.
Authority to prioritise activities	The planner sets the priorities in cooperation with the service manager.	The service staff set the priorities of their own tasks. The service managers support them in critical situations.
Cross-functional communication	The service manager or planner receives updates about the progress of core projects from the project team. The service manager has a continuous relationship with the sales unit regarding upcoming projects and contracts.	The service manager receives updates about the progress of core projects from the project team, customers or related internal or external contractors. The service managers and service staff are involved in sales activities and support the sales unit.
Categorising resources in the resource pool	There are specific resources for start-up and commissioning and ad hoc repair and maintenance.	There is no specific division of resources based on the type of activity.

4.2.1 Resource allocation practices in Company A

Traditionally, the service managers and service staff of Company A were responsible for planning different activities in the service unit, but this subsequently changed. At the time of the interviews, Company A had a hybrid resource allocation process, represented in Figure 1. Besides service managers and service staff, a planner exercised a critical role in allocating activities within the service unit. While the service staff played a significant role in managing their workload, they were required to communicate with the planner regarding any new activities or changes in their plans.

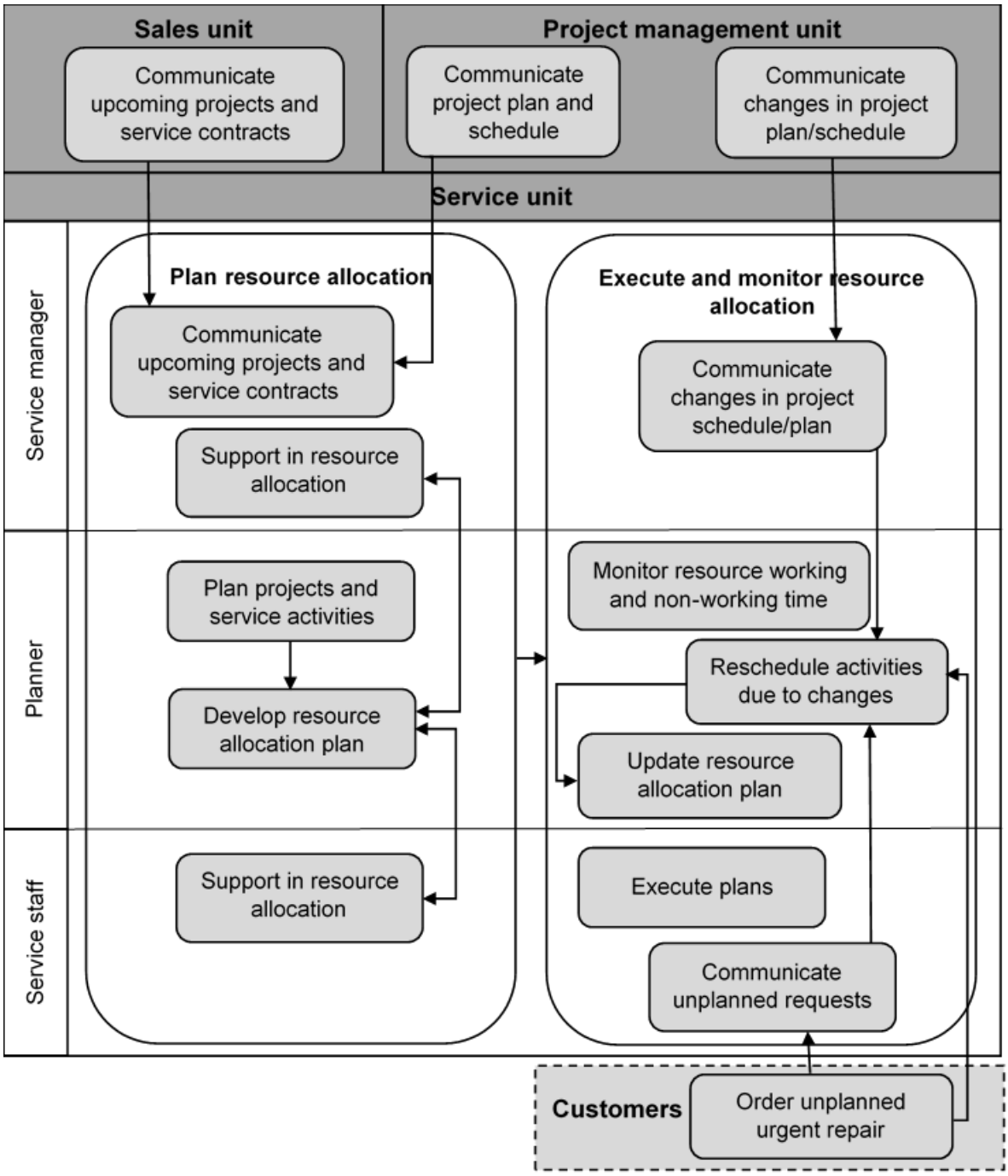

Figure 1. Resource allocation in Company A: hybrid resource allocation process

To improve resource utilisation in an environment of uncertainty, Company A dedicated specific staff to provide ad hoc repair and maintenance. This approach helped the unit control the effect of unplanned requests on other planned activities. Company A also allocated some of its service staff exclusively to commission new equipment. The service planner assigned these particular resources based on their technical skills. Different resource allocation strategies were

also used for more complex projects. For example, Company A assigned different staff for special equipment delivery projects to help the company increase its competencies in specific areas. While specific technicians are assigned to deliver these projects, the company also tries to rotate its resources. A manager in Company A explained, *"These projects are somehow special; therefore, we try to have a bigger team so they gain a detailed understanding about that specific delivery."*

While the planner, in cooperation with the service manager and service staff, developed plans for core project-related activities, service projects and contracts, unplanned and urgent requests from customers could change resource allocation decisions. Customers would usually contact service staff directly when they needed urgent repairs and maintenance services. To improve resource allocation, service staff would inform the planner of new customer requests and receive confirmation whether or not the new task has a higher priority than the planned activities.

Due to uncertainty in the environment, prioritising activities becomes an important practice in the service unit. The planner, with the help of the manager, schedules (and reschedules) project and service activities based on their priorities at the time the decisions are made. Serving the customers who have contracts with the firm takes the highest priority. Project activities are the next highest priority in the service unit. While members of the service unit try to allocate resources according to this deadline, they must consider the sizeable cost of shutdown for some of their customers in a specific industry and reprioritise activities to solve any urgent problems.

Uncertainties about the schedule of the start-up and commissioning phase of projects may cause difficulties in developing long-term plans and managing resource allocation. The product management unit of Company A was responsible for managing the core projects of the company. Project managers would communicate with service managers about project-related

services, project plans and resource requirements. As a manager in Company A explained, *"The service manager, together with the project manager, agrees on who will be sent to the projects and when."* To have an up-to-date schedule, the planner or the service manager continuously required information from the project management team about the project's progress. The communication and information flow between the project team and service unit would help the planner to release resources, allocate them to other important activities or find available resources whenever a project requires it.

4.2.2. Resource allocation practices in Company B

As presented in Figure 2, Company B took a different approach to resource allocation, here labelled as bottom-up resource allocation. The service managers gave more authority to the service staff and empowered them to make most resource allocation decisions on their own. Interviews with service managers and service engineers in Company B highlighted that due to a high number of unplanned customer requests, the service unit shortened the decision-making process to respond more rapidly to customer requests. Service engineers were required to prioritise their tasks, make their own timetables, communicate with customers and other units and update their plans frequently. A service manager in Company B explained, *"Service engineers can do those allocations by themselves. If they need help, then we can discuss it, but I am probably the last one to say what the most important task is*."

The service unit did not allocate specific service staff to specific types of activities, such as start-up and commissioning; rather any resources could be used for any activities, depending on their competencies. This approach helped Company B to use all available resources for different tasks, as well as to access various resources with the same level of skills and experiences. By accessing a bigger resource pool, the service unit could manage any changes to their plans more efficiently.

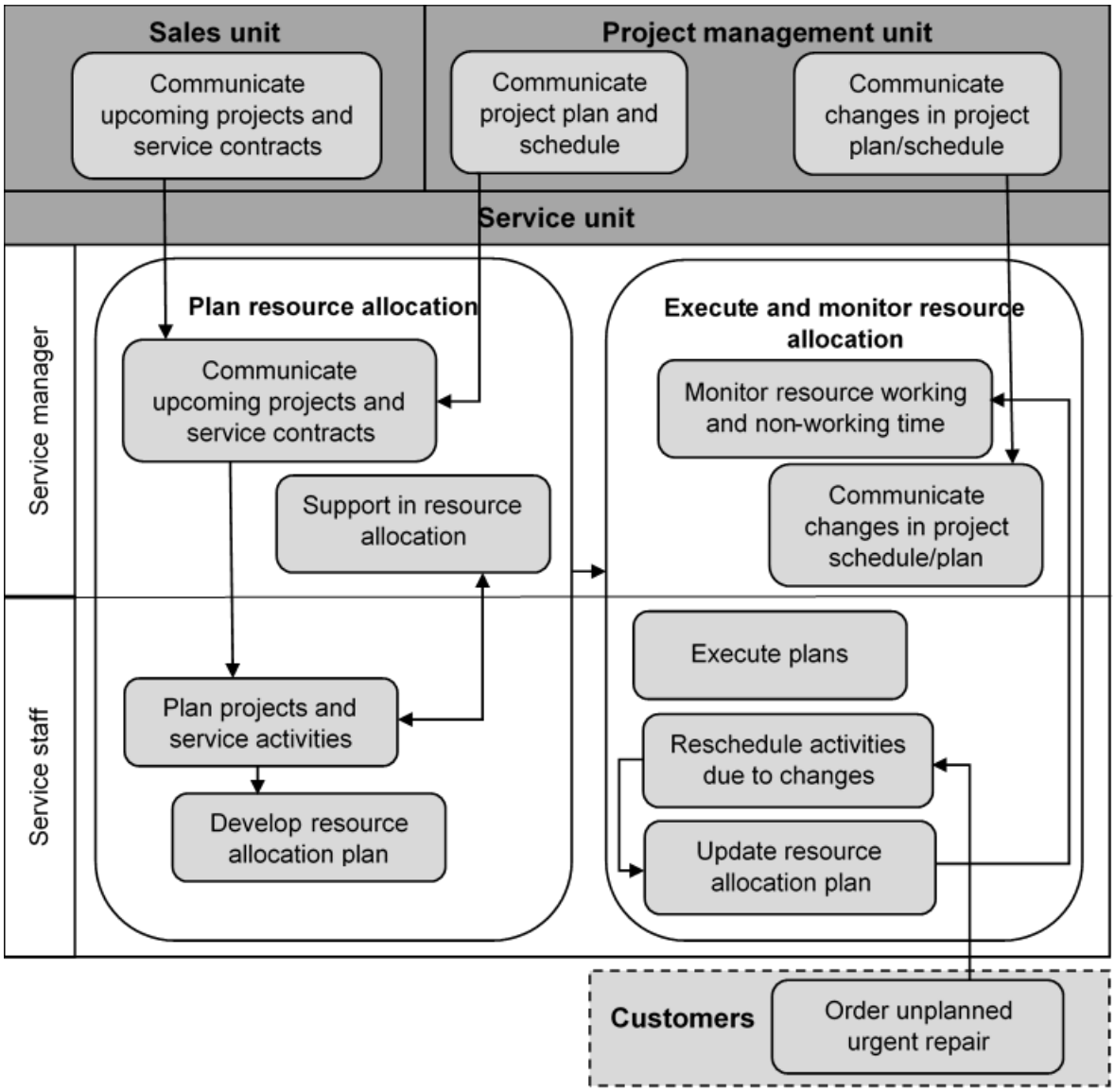

Figure 2. Resource allocation in Company B: bottom-up resource allocation process

The service staff in Company B was also required to respond to customers who have contracts with the company within a defined amount of time. Then, they could allocate their time to project activities and other service activities. However, Company B had a variety of customers in different industries, including such critical industries as transportation and nuclear power. Service staff had to respond to the urgent needs of these customers by reprioritising their tasks and postponing planned project and service activities.

Regarding start-up and commissioning, service managers were responsible for choosing those most suitable for projects. They made these decisions based on their skills and experiences and then checked the availability of these resources during the estimated timetable. Receiving up-to-date information about project progress played an important role in managing resource allocation. Service managers continuously received information about project progress from the project management team, customers or related internal or external contactors.

While Company B could not reduce the uncertainties arising from unplanned requests from customers, it did try to decrease uncertainties regarding service projects and contracts by maintaining a continuous relationship with the sales unit. The service staff usually accompanied the members of sales units on visits to customers and to make proposals. More experienced staff worked closely with the sales unit and received information about upcoming projects and contracts. This practice helped members of the service unit to have a more reliable picture about their future workload.

5. Discussion

This study focused on service units that operate in a dynamic environment where project-based firms use human resources for both project and service activities. It contributes to project contingency theory by revealing alternative resource allocation approaches in the specific organisational contexts of the project-based firms. Different project-based firms have specific critical characteristics that determines the suitable managerial approaches (Dvir et al., 1998; Shenhar, 2001). In project contingency research, construction projects, R&D and IT projects are the dominant project types (Hanisch and Wald, 2012), without a clear link to other types of activities in the firm. In the context of service-centric projects, previous research has pointed out the very different degrees of autonomy (including resource autonomy) across different types of projects and contexts (Martinsuo and Lehtonen, 2009). This study analysed service units in

engineering firms as a dynamic context where both project and service activities are carried out, and the changing needs of customers that must be taken into account. One of the key requirements for human resources in a dynamic environment is to respond quickly to changes. The study showed that based on the level of uncertainty in the environment and activities, service units may use different practices to allocate resources to projects and services.

5.1. Resource allocation approaches in context

This study reveals that two case companies working in a dynamic environment make multiple resource allocation decisions weekly or even daily. This increased frequency of resourcing decisions has made the traditional top-down approach an ineffective way for service units to allocate resources to project and service activities. The traditional view of resource allocation in project-based firms was based on a rational and hierarchical structure where managers would choose the most suitable resources and allocate them to various projects based on the pre-defined plans (Hendriks et al. 1999; Abrantes and Figueiredo, 2015; Ballesteros-Pérez et al., 2012; e Silva and Costa, 2013). The new approach employed by project-based firms highlights the relationship between the project and the parent organisation (Jacobsson et al., 2013) and emphasises the tensions that result from this interaction (Arvidsson, 2009). While earlier studies have demonstrated the needs for cross-functional negotiation (Laslo and Goldberg, 2008), they have considered the decision-making process mainly as an activity undertaken at the beginning of the project, although it may be rechecked periodically (Hendriks et al. 1999).

Control mechanisms vary across organisational settings (Canonico and Söderlund, 2010). This research argues that resource-related control mechanisms based on a hierarchy is a risky mechanism not only for complex, knowledge-intensive settings such as R&D-driven organisations (Canonico and Söderlund, 2010) but also for customer-facing units. To complement the previous top-down approach to resource allocation (Hendriks et al. 1999;

Abrantes and Figueiredo, 2015; Ballesteros-Pérez et al., 2012; e Silva and Costa, 2013), this study elaborated two alternative approaches to managing resource allocation, ones particularly prevalent in the customer-facing service units where project and service activities compete for resources. These are labelled in the study as *hybrid resource allocation* and *bottom-up resource allocation*. The study differentiates resource allocation of service units mainly based on complexity as one of the critical project dimensions (Baccarini, 1996). Table 5 depicts the contexts in which the two resource allocation approaches can be implemented, expected implications, the goals and the way used to implement each approach, based on the case study findings.

Table 5. Findings on hybrid and bottom-up resource allocation approaches

	Hybrid approach	**Bottom-up approach**
Where?	Medium complexity in terms of structural and emergent complexities (Maylor and Turner, 2017)	High complexity in terms of structural and emergent complexities (Maylor and Turner, 2017)
What?	Organising resources while increasing responsiveness	Increasing responsiveness
Why?	Ensuring the right prioritisation of activities in a dynamic environment	Reacting fast to the changes in time, scope and type of activities Adapting to uncertainties in the environment
How?	Using a planner as the intermediary role between managers and staff	Empowering individuals; managing the information flow between units; supporting by managers in critical situations

While both resource allocation approaches incorporate the experience and skills of staff in decision-making, *hybrid resource allocation* implies that a dedicated planner occupies the intermediary role between service managers and service staff. This approach helps the company to organise the resources in its continuously changing environment while maintaining its trust in individuals and valuing their roles in decision-making. By contrast, the other case company empowered its service staff to manage their activities in a bottom-up, customer-oriented and autonomous way. The study confirms that a dynamic project environment requires more flexible responses (Maylor and Turner, 2017; Jerbrant and Gustavsson, 2013). This approach helps the case company to respond to change more efficiently.

Analysing the organisational context of the two cases revealed the increased level of environmental uncertainty that arose in the case B. The considerable demand arising from unexpected requests from customers of Company B required a responsive approach to prioritising activities and allocating resources rapidly. Lindkvist et al.'s (1998) findings highlighted the use of time-control mechanisms in product development projects; in a similar way, this research demonstrated that determining priorities of activities in service unit defines what must be done and encouraged reflective activities that promote decentralisation, autonomy and self-organisation. This study investigated project-based firms from a practice perspective and showed the considerable effects of the organisation and its dynamic environment on resource allocation practices. The findings suggest that different risks and uncertainties in the organisational environment require different control modes in the project-based firms (Liu, 2015). Project-based firms need to understand the nature of their activities to choose the best resource allocation approach.

These findings have also emphasised the role of individuals' experiences in coping with unexpected events. The knowledge gained over time enhances the ability of staff to prioritise activities and manage tasks. By contrast, resource control mechanisms that emphasise plan-following and systematic change management can have adverse consequences on the resource allocation in a dynamic environment. While the behaviour of these more flexible organisations may appear as chaotic at a first glance, in fact they have learned to adapt successfully to their changing environment (Collyer and Warren, 2009).

5.2. Challenges in simultaneous delivery of projects and services

The results of this study direct attention to the challenges involved in delivering continuous and ad hoc services alongside planned and scheduled projects in project-based firms. While resource competition across multiple projects is a well-known issue (Fricke and Shenhar, 2000;

Laslo and Goldberg, 2008; Zika-Viktorsson et al., 2006), previous research has not sufficiently emphasised the competition for resources between projects and other types of activities in dynamic environments. This article has adopted a practice perspective and analysed the co-existence of projects and services within service units, thereby complementing previous studies concerning resource allocation in multi-project environments (e.g. Engwall & Jerbrant 2003). The previous studies on integrating projects and services have mainly emphasised the benefits arising from complementing projects with services (Artto et al., 2008), the necessity of changing the business logic (Kujala et al., 2011) and developing organisational capabilities (Brady et al., 2005; Davies and Brady, 2000). This study has shed light on the delivery of projects and services and revealed resource allocation issues to be key challenges stemming from the existence of multiple delivery logics.

The findings show that the service context, which has a direct connection with customers, ties project activities to an environment with high uncertainties. Both companies selected for this study are organised in a divisional structure. The service unit has focused on a narrow part of the solution life cycle; therefore, it has specific priorities related to its main function (Artto et al., 2008). In both companies, responding rapidly to customers takes the highest priority for the service staff, and these short response times affect long-term resource allocation and use. The specific function of service businesses (i.e. keeping the customers' operations up and running) changes the allocation of resources away from the projects' planned and scheduled approach to a continuously evolving prioritisation of activities.

Besides ensuring resource availability, continuous prioritisation of project and non-project activities is an important issue in organisations facing high uncertainty. The findings show that even if competencies are the main decision criterion in the planning phase of the core project, the service unit usually faces changing resource requirements in the project execution phase. In

addition to urgent repair and maintenance cases, deviation from other project activities that postpone the project-related services may have a considerable effect on resourcing decisions.

5.3. The role of communication and cooperation in enabling flexible resource allocation

In addition to choosing the appropriate resource allocation approach, communication and cooperation are important parameters to manage uncertainties in the service units. The results of this study show the importance of cross-functional links in project-based firms (Fricke and Shenhar, 2000) and the effects of information flow between different units on resource allocation. The interviews highlighted that managing the interfaces and the flow of information into and out of the project team helps firm manage uncertainties that result from organisational complexity (matrix structure) and from project changes and deviations. This lends support to earlier findings concerning the key role of boundary spanners such as project managers and project owners who have a key role in acquiring and guarding the project's autonomy (Martinsuo and Lehtonen, 2009). This study reveals the importance of accessing information about potential projects and contracts when managing resource allocation. Both case companies pursue up-to-date information about sales, requiring them to optimise the transfer of information to and from the sales unit. Besides using information systems, informal meetings and conversations with the sales force help the service unit to gain a larger picture of upcoming activities. As environmental uncertainties cannot be eliminated, information sharing makes it possible to manage their effects (Perminova et al., 2008).

6. Conclusion

6.1. Contributions and practical implications

In the cases studied in this research, service units organise their activities into projects and service activities and use the same resource pool to deliver both. In such an environment,

success of all activities is highly dependent on the resources available, and resource allocation is a critical process required to organise and manage both project and service activities. This challenge becomes more critical in dynamic organisations operating in conditions of high uncertainty. This study has reported evidence from service units to document more extreme cases where the activities competing for resources are highly uncertain in their scope and duration. Managing resources in such a dynamic environment requires an approach that allows a rapid response to changes, sharing information to facilitate decision-making.

This paper identified two main sources of resource allocation issues in an uncertain environment involving multiple types of activities, namely the dynamic nature of customers' service requirements and changes and delays to projects. Our research has shown that urgent requirements from customers may require the organisation to re-prioritise its activities continuously, re-allocating resources between projects and service activities while adapting plans to changes and delays in projects; this, in turn, calls for a cross-functional negotiation of priorities. This paper revealed two approaches used to organise this uncertain environment and to allocate resources, which have been labelled bottom-up and hybrid resource allocation. These approaches extend the findings of previous studies that have focused on top-down oriented resource allocation as an approach to adjudicate resource competition between projects in a multi-project environment where schedules and resources are planned by managers for projects in advance.

Utilising a bottom-up approach to increase responsiveness – i.e. ability to respond to the changes in the environment and customer requests fast - can results in some practical implications. First, balancing responsiveness with overall efficiency to deliver projects and services can become a challenge in service units, due to the internal competition for resources. In practice, in the bottom-up resource allocation approach, individuals may not be able to

allocate their time and efforts efficiently and may respond to the activities that are urgent but are not in the priorities of the firm. The result of this study shows that the supervising role of managers in these critical situations to set and negotiate priorities can enable the service units to balance responsiveness and efficiency.

Second, there is also a possible trade-off between responsiveness and nervousness. In one end, bottom-up approach can increase responsiveness. On the other end, it may increase nervousness by shifting from the original plans to frequently updated plans. The findings show that proper communication and coordination between the project team and the service unit as well as the service unit and the sales unit can help the service units to balance responsiveness and nervousness. Third, large global firms usually seek for a global optimal top-down approach with clear rationality and structure instead of a more flexible bottom-up approach, to enable forecasting and globally coherent service levels. Top-down resource allocation can be a suitable approach for those contexts where the firms assume good control over the sources of uncertainties. Therefore, when the context of the firm or unit shifts from a dynamic environment to a more stabilised environment, then they will need to reconsider the suitability of the top-down resource allocation approach.

This study recognises that a constantly changing environment requires a completely different, more dynamic logic for resource allocation compared to the previously dominant hierarchical model of resource planning used both in projects and within project portfolios. The results of the study show that service units can improve resource allocation between projects and services by managing the continuous changes in resource requirements of different activities. Moreover, exchanging information with other organisational units that are affected or can be affected by the resourcing decisions of service units can improve the interaction between services and projects.

6.2. Limitations and future research

This study was conducted in the service units of two manufacturing firms organised on a project basis, which limits the generalisability of its findings. The case studies also involved a limited number of interviewees in each company. To improve the validity of the results, interviewees were selected based on their first-hand experience and knowledge of different activities and of resource allocation processes in their units.

Most interviews were conducted with service managers and staff, so the experiences and opinions of other related units remain topics for future study. The interviews revealed that individual employees were becoming increasingly responsible to manage their own activities and to make their own decisions about time allocation. This kind of autonomy within project activities generates a need for research to assess the capacities of human resources working in uncertain conditions in project-based firms. This article directs attention to the delivery logic involved in complementing projects with services. Future research can investigate the challenges stemming from multiple delivery logics across various organisational contexts and, thereby, enrich research related to integrated solution provision.

This research studied resource allocation from a contingency perspective in service units that perform both project and service activities. The next stage is to study other types of organisations such as manufacturing units, and research and development units involved in project activities. Analysing resource allocation in different organisational contexts will help in determining the linkages between the level of uncertainty and resource allocation approaches.

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PUBLICATION III

Going downstream in a project-based firm: Integration of distributors in the delivery of complex systems

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Going downstream in a project-based firm: Integration of distributors in the delivery of complex systems

Khadijeh Momeni *, Miia Martinsuo

Tampere University of Technology, Laboratory of Industrial and Information Management, P.O. Box 541, 33101 Tampere, Finland

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Abstract

Research on the integration of different actors in project business has centered on the upstream value chain and a project-based firm's relationship with suppliers. The downstream delivery chain also includes an integration challenge as some project-based firms use distributors to sell and deliver systems. The purpose of this paper is to highlight the importance of integrating with distributors in the delivery of complex systems. A qualitative case study was conducted in one project-based firm. Different distributor capabilities were identified and grouped into business, relational, marketing, and delivery capabilities. Different integration mechanisms were mapped at business and project levels, and divided into control-, cooperation-, and development-oriented mechanisms. The findings show that distributor capabilities related to complex system delivery develop through repetitive collaboration across projects. The stable position of distributors in the downstream value chain facilitate the use of integration mechanisms at the business level and development-oriented integration approach at the project level.

Keywords: Distributors; Distributor integration; Capabilities; System seller

1. Introduction

Project-based firms in the international field require various business relationships in the wider environment (Skaates and Tikkanen, 2003). These business relationships deal not only with the project itself but also with business more generally as the relationship between actors needs to continue even after the projects are completed (Hadjikhani, 1996). Project-based firms need to co-operate with various actors in their global network (Skaates and Tikkanen, 2003) and integrate multiple organizational units and geographies (Turkulainen et al., 2015) in project delivery and between projects. Integrating project-based firms with customers, suppliers, and other firms adds complexity to the business of project-based firms. As part of the global business environment, project-based firms that deliver complex systems sometimes utilize other firms as distributors to offer products and services to their target customers, and the project-based firm's relationship with distributors is the focus of this paper.

Literature on project-based firms has covered the supply chain and project-based firms' relationship with suppliers and buyers' relationships with contractors extensively. Researchers have emphasized the significance and dimensions of such primary relationships (Aagaard et al., 2015; Pinto et al., 2009). In addition, studies have paid attention to integration mechanisms and suggested different mechanisms for integrating suppliers with a project-based firm (Eriksson, 2010; Martinsuo and Ahola, 2010). However, little is known about what project-based firms expect from distributors and how project-based firms can integrate the distributors in the firms' business effectively. Distributors' status in the marketing channel has previously been covered in industrial marketing research in terms of distributor selection criteria (Cavusgil et al., 1995; Kaleka, 2002; Lin and

* Corresponding author.
E-mail addresses: khadijeh.momeni@tut.fi (K. Momeni), miia.martinsuo@tut.fi (M. Martinsuo).

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Chen, 2008; Piercy et al., 1999; Sharma et al., 2007; Zou et al., 2011) and the relationship between the focal firm and the distributor (del Bosque Rodríguez et al., 2006; Goodman and Dion, 2001; Ghosh et al., 2004; Liu et al., 2007; Nes et al., 2007). However, researchers have directed less attention to the emerging requirements of manufacturers that provide complex systems than to standard products and services. The present study addresses this research gap by exploring the expected distributors' capabilities and required integration mechanisms with distributors in a project-based firm.

The use of distributors is particularly prevalent in engineer-to-order (ETO) manufacturing where the project-based firm sells, designs, and manufactures customer-specifically tailored systems, such as equipment or processes, repeatedly, based on customers' orders. In ETO manufacturing of complex systems for business customers, unique customer orders are handled as projects (Yang, 2013). Therefore, ETO manufacturing is characterized by time-limited projects that respond to specific customers' requirements with the same discontinuity aspect as engineering and contracting projects (Caron and Fiore, 1995). However, firms with ETO manufacturing are different from traditional engineering and construction firms mainly in terms of the repetitiveness of similar types of projects and the use of defined production systems (Caron and Fiore, 1995). This characteristic enables and even requires project-based firms with ETO manufacturing develop more durable relationships with their partners, in the upstream and downstream of the value chain.

The discontinuity of demand for projects, the uniqueness of each project, and the complexity of each project in terms of the number of actors involved throughout the supply process make project business different from other business-to-business marketing situations (Hadjikhani, 1996; Skaates and Tikkanen, 2003). Delivering customized systems requires specific project capabilities, including bidding, customer order-specific project design, implementation, and commissioning (Davies and Brady, 2000). However, the project-based firm does not always accomplish all these tasks by itself; the capabilities for unique projects may be scattered throughout the project business network, in the upstream and downstream value chains. In the downstream value chain, distributors as possible collaborators with the project-based firm need to prepare, organize, and control a specific contract for each customer and potentially also promote or deliver post-project services. Integration with distributors is particularly important in project-based firms where relationships with customers are crucial in ensuring the success of projects (Dvir, 2005) and where they need early discussions and cooperation with customers to understand their strategic needs and priorities to sell and define the project (Brady et al., 2005). To benefit from distributor collaboration, project-based firms need to know and understand the capabilities of the distributors, as well as help the distributors develop new capabilities of system integration and solution selling.

1.1. Research goal and questions

This study focuses on a project-based firm's expectations for distributors' capabilities and required integration mechanisms with distributors in the delivery of complex systems. The goal is to offer new knowledge on how the project-based firms can "go downstream" by developing their distributor cooperation. The main research questions are:

1. *What capabilities does a project-based firm require from distributors in delivering complex systems?*
2. *How does the project-based firm integrate distributors in the delivery of complex systems?*

The study contributes by identifying the specific capabilities that project-based firms require from distributors and thus, offering information on the areas of distributor development for the project-based firm's collaboration in the downstream value chain. This study also initiates research on the role of distributors in delivering complex systems and highlights the need to consider different ways of integrating distributors.

To respond to the research questions, a single case study was conducted in a project-based firm that designs, sells, and delivers complex systems to business customers. The focus is delimited to ETO manufacturing of complex systems in a business-to-business setting—in this case, equipment and processes—where the focal firm has a central role and uses external distributors in system delivery to customers. More challenging integrated solutions delivered in project networks and ETO manufacturing in consumer businesses are not covered. By taking the inside project-based firm perspective, the study is delimited to viewpoints and experiences of the project-based firm's personnel. We leave for future studies the broader analysis of experiences from distributors' perspectives.

2. Literature review

2.1. Role of distributors in project-based firms

Project-based firms in industrial markets increasingly provide solutions that include complex product systems or capital goods and related services to industrial customers (Artto et al., 2015). Projects have been used as a common organizational form of delivering systems and integrated solutions (Davies and Hobday, 2005). Solution providers concentrate on creating value for customers to increase their business potential in the markets (Artto et al., 2008). Literature acknowledges that customers can be part of the value creation process. Customers can be an important information source, and close communication with customers can help firms have a better understanding of project needs (Kim and Wilemon, 2002) and ensure value-in-use is realized for customers (Storbacka, 2011). Studies on customer involvement have mainly focused on the relationship between project-based firms and customers (Dvir, 2005), and studies on project marketing have emphasized the interaction between a project-based firm and its customers in times of discontinuity (Cova et al., 2002; Hadjikhani, 1996). Although previous studies highlighted the need to study the relationships with key actors in the project milieu more broadly (Cova and Salle, 2005), research on the intermediaries between the firm and the customer to explore

what they can bring to the value chain and how they can be integrated in project business successfully is lacking.

Distributors have an increased role in sales channels especially in manufacturing firms (Ghosh et al., 2004). Project manufacturing or ETO manufacturing firms are involved with selling, designing, manufacturing, installing, and commissioning complex systems to fulfill unique customer requirements (Caron and Fiore, 1995). In this high-tech manufacturing environment that delivers complex systems to customers, customers are involved actively in defining the result of the project (Yang, 2013). When firms are or become global, they need to be able to deliver projects to their global customers in different locations. The firms usually face the pressure of globalization through launching new operation sites in multiple geographic locations (Turkulainen et al., 2015) and/or distributing sales and service organizations globally (Artto and Kujala, 2008). Global firms that develop, sell, and deliver customized solutions use distributors to save money, utilize local expertise, and maximize coverage in their global markets (Lin and Chen, 2008).

Project-based firms that supply ETO manufactured systems and products utilize the distributors' vast amount of market and customer knowledge to find the right customers and maintain relationships with them. In the global business environment, distributors are the representatives of the firms in their specific markets and have a direct relationship with customers. This special role in finding new opportunities in the market makes the distributors' position more stable and continuous in the project business network in comparison with suppliers that are usually engaged only after the project is created. Distributors are independent business entities that can have different policies, procedures, and goals in comparison with manufacturers (Goodman and Dion, 2001). Distributors in the same way as customers seek monetary and non-monetary benefits from relationships with project-based firms (Ghosh et al., 2004). These benefits and issues make building and maintaining project-based firms' relationships with distributors important and challenging. Because a large project is a dynamic network of organizations, the project must focus on integrated capabilities and not on an individual's actor capabilities (Ruuska et al., 2013). The previous literature mainly studied buyer–supplier and subcontracting relationships. However, it is necessary to go downstream in the value chain also, to analyze the integration mechanisms between firms and their distributors.

2.2. Distributor capabilities

Literature on distributor selection addresses different capabilities that firms should seek in their distributors. In this context, capabilities mean the firm's ability to combine, develop, and use its resources in order to create competitive advantage (Kaleka, 2002). Scholars have provided different categorizations for distributor capabilities. Several authors defined sets of capabilities (Cavusgil et al., 1995; Lin and Chen, 2008), and several authors identified individual capabilities (Sharma et al., 2007; Zou et al., 2011). Others divided capabilities into a set of resources and skills (Kaleka, 2002; Piercy et al., 1999). In addition to minor differences in defining the set of capabilities, there is a consistency in distributors' individual capabilities. We categorized the capabilities identified in previous studies into three general domains of distributor capabilities: business, technical, and relational capabilities.

Business capabilities refer to financial capabilities (Cavusgil et al., 1995; Kaleka, 2002; Lin and Chen, 2008; Zou et al., 2011), reputation (Cavusgil et al., 1995; Sharma et al., 2007), management ability (Cavusgil et al., 1995; Lin and Chen, 2008; Zou et al., 2011), physical facilities (Kaleka, 2002; Lin and Chen, 2008; Zou et al., 2011), and market experience (Cavusgil et al., 1995; Lin and Chen, 2008). Financial capability as one of the most-cited capabilities can be further analyzed as an ability to finance initial sales and subsequent growth, to raise additional funding, to provide adequate promotion and advertising funds, and to maintain inventory (Cavusgil et al., 1995; Sharma et al., 2007). Reputation defines the position of the firm in managing the business and maintaining relationships with customers (Sharma et al., 2007). Cavusgil et al. (1995) suggest that companies need to evaluate the standing of distributors with current and past customers, suppliers, the local business community, and competitors. Management ability relates to the quality of the management team (Cavusgil et al., 1995) and operational competency (Lin and Chen, 2008). Physical facilities consist of the modern technologies and equipment required to carry out distribution tasks (Kaleka, 2002; Lin and Chen, 2008). Market experience is also considered an important strength that enables a distributor to gather relevant information, decrease uncertainty, and better handle managerial resources (Lin and Chen, 2008).

Technical capabilities consist of several crucial capabilities that have been categorized from different viewpoints. Generally, these capabilities include product, marketing, logistics, delivery, and innovation capabilities. Product capabilities mainly refer to product knowledge and providing compatible and complementary products (Cavusgil et al., 1995; Lin and Chen, 2008). Marketing capabilities generally include experience with target customers, geographic/market coverage, and sales strength (Cavusgil et al., 1995; Lin and Chen, 2008; Zou et al., 2011). Logistic capabilities refer to inventory management and ability to control logistics costs (Lin and Chen, 2008). Delivery capabilities are another key determinant of a successful distributor and refer to delivery efficiency, customer service (Cavusgil et al., 1995; Li and Chen, 2008), and flexibility to respond to special customer requests (Lin and Chen, 2008). Finally, innovation and product development capabilities have been identified as key success factors of distributors in previous research (Lin and Chen, 2008; Sharma et al., 2007). These capabilities deal with the ability of the distributor to help the manufacturer with innovative suggestions for improvements (Sharma et al., 2007).

In addition to these tangible capabilities, relational capabilities affect the competitive advantages of distributors (Kaleka, 2002). Commitment and willingness are the main elements of this set of capabilities. Relational capabilities may include the

willingness to share information (Frazier et al., 2009; Goodman and Dion, 2001; Lin and Chen, 2008), enthusiasm about building a relationship, and commitment to invest in the relationship (Kaleka, 2002; Lin and Chen, 2008). Moreover, willingness to maintain sufficient inventory, willingness to commit advertising dollars, commitment to achieving minimum sales targets, undivided attention to product, willingness to invest in sales training, and willingness to drop competing product lines (Cavusgil et al., 1995) can be considered relationship capabilities.

Previous studies mainly studied capability attributes through surveys in industrial manufacturing firms (Kaleka, 2002; Lin and Chen, 2008; Zou et al., 2011) or analyzed manufacturers' perspectives through interviews (Cavusgil et al., 1995; Sharma et al., 2007). In such studies, the focal firms have been industrial manufacturing firms that produce standard equipment in medium to high volumes instead of customer-specifically tailored complex systems and solutions. Wang and Kess's (2006) study of case studies representing Finnish manufacturers and Chinese distributors is one of the few studies that are closer to engineer-to-order systems than standard production. The study emphasized the importance of a product-centric relationship between a firm and its distributors. However, Wang and Kess's (2006) research tends to focus exclusively on the motives of partnership and mutual selection between manufacturers and distributors, instead of integration during projects.

Although some sets of capabilities (such as business, marketing, and relational capabilities) have been emphasized and analyzed with the help of literature on supplier selection, the capabilities required for firms that deliver customized systems to target customers were not clarified in previous studies. Literature on project-based firms tends to focus on the upstream value chain and provides insights into the required supplier capabilities (Ruuska et al., 2013). Project-based firms that utilize distributors in their delivery chain are dependent on the distributors' capabilities in their customer relationships. Therefore, there is a need to study the downstream value chain to discover the required distributor capabilities for delivering complex systems to global customers.

2.3. Integration of external actors in project-based firms

An important question for project-based firms is how they can integrate the capabilities of external actors—in this study, distributors—and use them effectively, in their project business. Vertical and horizontal linkages in the value chain of a firm (Porter 1985) imply the need for integration, i.e., acquiring, sharing, and consolidating knowledge within the organization itself and with its external stakeholders (Swink et al., 2007). Previous studies have recognized different forms of internal and external integration and their effects on each other and organizational performance (Droge et al., 2004; Germain and Iyer, 2006; Swink et al., 2007).

The project-based firm's distributor collaboration deals with external integration. We adopt the definition of external integration from Germain and Iyer (2006) and define external integration as "unified control of functions and processes across trading partners." Trading partners can usually be divided into the actors in the upstream and downstream of the value chain. The upstream integration research mainly studied supplier and contractor integration in manufacturing firms (Droge et al., 2004; Zhao et al., 2011). Studies on downstream integration have been limited to building collaborative relationships between manufacturing firms and customers (Germain and Iyer, 2006). As research on the integration of distributors with project-based firms has not been conducted, other relevant literature was studied to identify different inter-organizational integration mechanisms, such as customer integration, the project-based firm–supplier relationship, the project-based firm–contractor relationship, and project networks.

Literature on customer integration mainly focuses on the effect of customer involvement on project success (Peled and Dvir, 2012), different aspects and interfaces for customer integration (Voss, 2012), customers as an important information source (Kim and Wilemon, 2002), and users as co-developers (Hsu et al., 2011). Such previous research has mainly been conducted in product development projects and not in the context of delivering complex systems. Moreover, the literature has mainly focused on the early phases of the project life cycle (i.e., design and development).

Literature on supplier integration emphasizes several benefits of supplier integration (Primo and Amundson, 2002; Ragatz et al., 2002; Song and di Benedetto, 2008) and has revealed the critical elements for enhancing the supplier relationship (Cheung and Rowlinson, 2011). Some studies also suggest mechanisms and practices for integrating with suppliers. Among those studies, researchers used similar categories for integration mechanisms: control-oriented (Martinsuo and Ahola, 2010) and cooperation-oriented (Martinsuo and Ahola, 2010; Sariola and Martinsuo, 2015). Control-oriented mechanisms deal with supplier selection, supplier assessment, and boundary objects. Cooperation-oriented mechanisms direct attention to managing the day-to-day supplier relationship during project execution (Martinsuo and Ahola, 2010). Table 1 summarizes the supplier integration mechanisms suggested in the literature.

As can be seen in Table 1, the majority of suggested mechanisms can be categorized as control- or cooperation-oriented mechanisms. The previous literature has additionally identified some development-oriented mechanisms (Eriksson, 2010; Martinsuo and Ahola, 2010), but they are discussed less. It has been recognized that supplier integration mechanisms require a long-term commitment between project-based firms and suppliers to enable the project-based firm to know the supplier well and align the roles and characteristics of the buyer–supplier relationship (Martinsuo and Ahola, 2010). Thus, previous research highlights the role of the focal firm in helping suppliers develop their capabilities over long periods. Furthermore, all previously studied integration mechanisms mainly happen during a specific project. It is not clear from previous studies whether mechanisms can be performed at the business level to improve integration between two actors. As an exception, Sariola (2018) identified different mechanisms at the project and business levels and considered development-

Table 1
Summary of supplier/contractor integration mechanisms in previous research.

Mechanisms	References
Control-oriented mechanisms:	
Supplier selection	Martinsuo and Ahola, 2010; Watt et al., 2010
Shared goals, instructions, agreements, tools, etc.	Eriksson, 2010; Benjaoran, 2009; Martinsuo and Ahola, 2010; Brady and Davies, 2010; Badi and Pryke, 2015
Monitoring	Martinsuo and Ahola, 2010
Cooperation-oriented mechanisms:	
Integrative individual roles, e.g., liaison	Martinsuo and Ahola, 2010; Taylor et al., 2015
ICT integration and knowledge sharing	Cheung and Rowlinson, 2011; Fulford and Standing, 2014; Pala et al., 2014; Aloini et al., 2015; Taylor et al., 2015
Informal interaction/ communication	Martinsuo and Ahola, 2010; Taylor et al., 2015; Taylor et al., 2015
Shared office for project work	Eriksson, 2010
Team building/ integrative teams	Eriksson, 2010; Martinsuo and Ahola, 2010
Development-oriented mechanisms:	
Training	Eriksson, 2010; Martinsuo and Ahola, 2010

oriented mechanisms. However, his study was limited to construction projects and solely explored innovation practices instead of integration mechanisms more generally.

Literature on contactor management also emphasizes the benefits of integration, including exchanging knowledge and information among actors at different levels of interactions (Khalfan and Maqsood, 2012), developing a knowledge management system (Khalfan and Maqsood, 2012; Nesheim and Hunskaar, 2015), and promoting innovations (Badi and Pryke, 2015). The mechanisms identified for integrating a contractor's capabilities include transferring and retaining knowledge, encouraging a social network, appraising the contractor's performance, creating a capability development group (Taylor et al., 2015), and cooperating informally across sub-contractors (Aagaard et al., 2015).

Literature on project networks is another stream of research that studies inter-organizational mechanisms, especially in large and complex projects. However, previous studies mainly focused on creating and maintaining the relationship between actors, rather than integration mechanisms specifically. The network structure and new roles and responsibilities, such as coordinator, gatekeeper, and mediator, are highlighted as a means for smoother coordination of the relationships (Pauget and Wald, 2013). Cooperation develops in project networks by creating interpersonal relationships, maintaining open and efficient communication, identifying and expressing mutual benefits, and cooperating outside the projects (Sariola and Martinsuo, 2015). Informal mechanisms (such as shared offices for project work, informal social events, and continuity of personnel) can also enhance cooperation between actors (Bresnen and Marshall, 2002).

Altogether, integration with external actors has been recognized as one source of competitive advantage, and different mechanisms—techniques, tools, and approaches—were identified to develop external integration. Although previous studies on the downstream in the value chain show mainly the importance of cooperation-oriented mechanisms with customers in the early phase of the project, literature on suppliers' and contractors' integration reports different control- and cooperation-oriented mechanisms during the different phases of the project life cycle. Given the relatively scarce literature on distributor management in project-based firms, this study focuses on the unique role of distributors in project business, where they need to understand customers' specific needs, transfer information to project-based firms, and deliver different systems to customers. With respect to the differences between governance of the customer and supplier relationship, suppliers and distributors have a similar perspective regarding the project-based firm: They are both independent business entities with different policies and procedures that provide complementary resources, skills, and knowledge to the focal firm. However, the upstream vs. downstream value chain position differentiates suppliers and distributors quite clearly. Thus, this research helps to open up new avenues to understand downstream integration in particular, compare relationships upstream and downstream in the value chain, and figure out possible different approaches to integration.

3. Research method

To deepen understanding of the distributor capabilities required for delivering complex systems and distributor integration mechanisms in project-based firms, a qualitative case study was conducted in a global technology leader firm that provides comprehensive process designs, parts, complex systems, and full services to business customers in a certain domain of the mechanical engineering industry. The case study allowed the researchers to analyze a phenomenon based on experiences and opinions of people in their real-life context (Yin, 2009). As the project business literature has not studied the relationship with distributors, a single case study was chosen to explore this topic and find relevant issues in an empirical setting.

The single case study was implemented to study a representative case (Yin, 2009, p. 48) using purposeful sampling (Silverman, 2010, p. 141). The case firm was selected based on its ETO manufacturing character and extended use of distribution channels to supply its customers with systems and after-sales services, and the firm's interest in developing distributors and distributor management. While previous studies in distribution management have been conducted in industrial manufacturers that offer standard products, we purposefully selected a manufacturing firm that delivers complex systems as projects. We also selected a firm whose distributors are not only resellers but also collaborated with the project-based firm while executing projects. The distribution management teams of the case company, located in different geographic regions, were selected as the level of analysis.

3.1. Case context

The firm is the world's leading industrial manufacturer in its industrial markets. The case company is the brand name owner and system integrator that is in charge of project sales, deliveries, transactional deliveries, and assembly manufacturing of the complex systems (including a technical product system and related services). It is a typical example of project manufacturing or ETO manufacturing firm that handles unique orders as projects (Yang, 2013). The firm is considered a project-based firm as selling and delivering projects is their primary business, and they are the system integrator that integrates all the main business functions of the firm and external actors' knowledge into the complex systems (Hobday, 2000). System delivery can imply delivering a single piece of equipment or a broader manufacturing solution, including multiple different pieces of equipment. The complexity of the system delivery is mainly defined in terms of technological complexity (engineering requirements), commissioning complexity (environmental considerations and integration with manufacturing system), and the size of the project (number of subsystems). Customers vary from small to big companies in a certain process industry.

The firm has divided the global market into 13 regions. Ten regions use distribution channel partners, and three have a direct sales organization owned by the focal firm. This study concentrates on the 10 regions that use distributors. Distributors are the main channel for selling equipment and systems and providing services in a given region and are responsible for the day-to-day contacts with customers. One of the main reasons for using distribution channels instead of a direct sales organization is to reduce overhead costs and save resources by transferring the responsibility of holding inventory to distributors. Another important benefit of distributors is that they provide local expertise and knowledge and provide maximum coverage and presence in the market.

For each region, the focal firm has distribution managers who manage the distributor portfolio in a few countries with the help of a distribution management team, possibly including service managers and specialists. Distribution managers are responsible for day-to-day management and interaction with distributors and usually report to a distribution director in a given region. Finally, the head of distribution manages all efforts at the global level: sets the vision, evaluates the total performance, and defines strategies and targets.

3.2. Data collection and analysis

Data were collected through semi-structured interviews with the head of distribution, eight distribution directors, a technical support director, and a training manager. The interviewees were selected in collaboration with the head of distribution team, because they are such key informants who had first-hand knowledge of the firm's current distributors, distributors' capabilities and tasks, the firm's own business and related requirements for distributors. In total, 11 interviews were conducted lasting between 38 and 90 min with an average of 60 min. Three interviews were held face-to-face, and eight interviews were held by telephone.

A thematic outline was designed for the interviews so that the interviewees were allowed to talk about their own experiences and expectations regarding distributors and distributor cooperation freely, but at the same time to enable sufficient consistency between the interviews. The questions were open-ended: No pre-defined categories were offered by the interviewer at this stage. The main themes of the interviews included the role of the distributors, the organizational structure for the distribution channel, distributors' required capabilities, relationship with distributors, integration with distributors in different phases of system delivery, and general issues in the firm–distributor relationship. Further detailed sub-questions were used to prompt and expand the interviewees' responses, where needed. All interviews were recorded and transcribed. In addition, different documents, such as distributors' evaluation process, training programs, and a sample of the training materials, were utilized to supplement the interviews.

The data analysis was conducted in four steps. First, the transcriptions were read through and explored inductively to identify distributor capability areas and recognize the areas where distributor integration occurred. At this point, the data appeared to be very suitable for the research intent, and the interviews offered sufficiently versatile data for the analysis. The discovered tentative topics were then reflected upon previous literature, to define more specific codes and categories for a more detailed analysis.

Second, by going back and forth between the literature and the data, a categorization and coding scheme was developed for coding the data for distributor capabilities and for integration mechanisms. For capabilities, a rough categorization of business, relational, marketing, and delivery capabilities was used, building upon previous literature, and further fine-tuned based on the interview data. A more detailed coding for each category took place inductively, and the coding approach and illustrative quotes are shown in Table 2. For integration mechanisms, the data were categorized as business- or project-level actions inductively, as the interviews clearly differentiated between integrative actions in single delivery projects and such actions that took place more generally, concerning the business across and between projects. Project-level actions were those that could be mapped to each phase of the project separately. Other general actions were labeled as business-level actions. The coding structure, definitions, and further details are shown in Table 4. Furthermore, for project-level actions, the type and intensity of the relationship between the project-based firm and distributors were mapped in the life cycle of the system delivery based on interview data. The details of distributors' involvement in system delivery are shown in Fig. 1.

In the third step, the interviews were compared to each other to identify the level of emphasis of each capability, assessed based on how frequently the issue emerged as part of the interviews. We used the labeling system suggested by Hill et al. (2005): "General" includes capabilities that were stated by almost all interviewees. "Typical" includes capabilities that

Table 2
Required distributor capabilities from the project-based firm's point of view.

Categories	Capabilities	Sample quote	Level of emphasis by the interviewees
Business capabilities	Financial capabilities	*"Distributor should have solid financial background and be a profitable company, so they can invest in our business"*	General
	Dedicated organization or people	*"We are trying to see if there are some dedicated personnel in the organization for us. It's true that sometimes we share these people with other brands, but we want to have at least some people for capital sales and for service sales."*	Typical
	Capabilities related to inventory management	*"They should have enough space, enough wares, and a system that they can deliver to the customer quickly."* *"It is important that they do not have wrong items in inventory because then it is very costly, and they lose financial efficiency."*	Typical
	Capability to work with IT-based tools	*"We are implementing some new IT, CRM (customer relation management) tool so they would have to have the ability to use them."*	Variant
	Capabilities to provide complementary products	*"It is important to see how distributors combine our product along with the other products to add value to the customer."*	Variant
Relational capabilities	Sharing product development opportunities	*"They [distributors] are advisors; they give us positive or negative feedback that "This is the problem, this is the issue, and this is how it can be improved."*	Typical
	Sharing market intelligence	*"They are part of the local industry community. They go to different meetings, they know if any big projects is coming, they see activities of competitors in the market and share this information with us."*	Typical
	Enthusiasm and aggressiveness	*"We should look for a more hungry company that can devote time to our business."*	Variant
	Commitment to development	*"For example, it is not necessary that they have the right organization in place in the beginning, but they should have a commitment to develop it. They should be committed to take people on and participate in our training program."*	Variant
Marketing capabilities	Market and industry knowledge	*"We will look for a company who is actively engaged in our business. They may not be dealing with the same equipment but they may be dealing with equipment of any other peer group industry. That would be our preference. So they know about the industry, they also know about our customers. Then it will be easier for them to try to push our business."*	General
	Capabilities to manage customer relationship	*"After-sale relationship is critical. They have to have high business skills and excellent relationships with customer."*	General
	Sales capabilities	*"They have to be able to have all sales competencies; they can create an interest, negotiate, and close the deal on a reasonable number of occasions. We are also focusing on how well they are able to prepare quotations, to handle all these quotations, to know if they are also able to manage their receivables."*	General
	Geographic coverage	*"You [distributor] have to have the maximum coverage and presence in the market."*	Typical
Delivery capabilities	Technical knowledge and skills related to products and processes	*"Those guys [distributors] have considerable knowledge about the products and they have a lot of experience. We are also making sure that they have knowledge of the process. In our business, it is critical to know the process behind and the characteristics of material and environment."*	General
	Capabilities to deliver services	*"We would always look for distributors who have the service and support ability. It would be very high up in the list of requirement. You certainly would not want to be employing a distributor who has no service capability."*	General
	Capabilities to deliver customized solution/ systems	*"We are not only selling a standard product on the brochure. This is something that we have to consider. Distributors are the first contact for the customer for any kinds of projects. We [company and distributor] make the proposal together. We negotiate with the customer and close the deal."*	General
	Capabilities to deliver commissioning and start-up	*"So the expectation would be that anything that is not for the first time or unusual, the distributor would be able to commission it."*	Typical

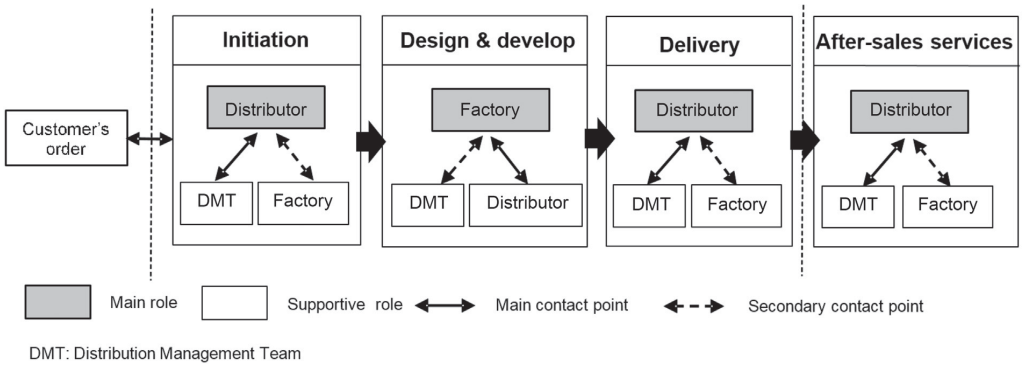

Fig. 1. Distributors' involvement in the system delivery process.

were found in more than half of the interviews. "Variant" includes capabilities that were emphasized in at least two interviews but fewer than half. We did not aim to quantify the qualitative data or to use this categorization instead of actual evidence, but we utilized the labels to illustrate the strength of the interview evidence and communicate the results. Moreover, the data concerning integration mechanisms were further coded according to the literature review and interview data in terms of the types of integration mechanisms into cooperation, control (in line with Martinsuo and Ahola, 2010), and development-oriented mechanisms. These details are included in Table 4. The transcriptions were analyzed based on the codes, and related quotations were identified.

To draw conclusions about the identified capabilities and integration mechanisms, we conducted the fourth step and looked at the capabilities and integration mechanisms in relation to the project-based firm. The capabilities were grouped based on their evolving nature throughout the distributor relationship, as the interviewees differentiated between their expectations toward new and experienced distributors and distributors from different cultures. The details of codes and related capabilities are shown in Table 3. The categorization of integration mechanisms defined in the previous steps was cross-tabulated, to map what type of integration mechanisms are more relevant at the project level and business level. Details are included in Fig. 2.

The given documents were utilized to triangulate the information expressed by the interviewees. Excerpts from the interviews are used in the Results section to highlight the viewpoints of interviewees on the required capabilities of distributors and integration mechanisms.

4. Results

4.1. Required distributor capabilities

The most important capabilities that the case company's distribution managers use to select and evaluate distributors are shown in Table 2. These capabilities can be categorized into four main groups: business, relational, marketing, and delivery capabilities. The most frequently stated capabilities are delivery and marketing capabilities. However, interviewees also emphasized the importance of financial capabilities as a central criterion for choosing distributors and relational capabilities as supportive requirements.

Business capabilities: Starting with business capabilities, respondents identified financial capability as the most important factor when choosing a distributor. The distributors need to have a strong financial level to take financial risks and purchase and stock the firm's equipment and spare parts to meet the end customers' demands. As most distributors represent different brands in their region, the distributors need to have a special organization or at least specific staff dedicated to the firm's business. The distributors should have infrastructure such as a main office and branches (if needed), IT facilities, and warehouses to store the stock. Inventory management is another business capability. The distributors need to have the knowledge and skills to have the right inventory in their warehouses. Capability to work with the firm's IT-based tools

Table 3
Categorization of capabilities based on their evolving nature during the relationship.

Required capability according to phase of the relationship	Capabilities
Capabilities that are required from the early stages of the relationship	Business capabilities Marketing capabilities Enthusiasm and aggressiveness (relational capabilities) Commitment to development (relational capabilities) Knowledge and skills related to products and processes (delivery capabilities)
Capabilities that are required to evolve during the relationship:	
Capabilities that are dependent on the length of the relationship	Capabilities to deliver customized solutions/ systems (delivery capabilities) Capabilities to deliver commissioning and start-up (delivery capabilities)
Capabilities that are dependent on the culture of the distributors	Sharing market intelligence (relational capabilities) Sharing product development opportunities (relational capabilities)

	Project level	Business level
Development oriented	Joint commissioning; Support for service business	Training program; Development of suitable organization; Shared offices for development activities
Cooperation oriented	Joint customer visits and meetings; Support in developing proposals	Trust-building; Informal activities
Control oriented		Evaluation of distributors; Monitoring of distributors; Integrative ICT tools

Fig. 2. Mapping integration mechanisms based on the type and usage level of the mechanism.

is least important for distribution managers, but the importance increases over time. The head of distribution explained, "IT capability would be down the list of our priorities. However, five years ago, it was not on the list, and now, it is on our list. So I would expect, as things evolve, its position on the list will actually increase." The interviewees also preferred distributors that could provide complementary products to add value for customers.

4.1.1. Relational capabilities

Relational capabilities were not explicitly mentioned in the official list of the firm's distribution selection criteria or the evaluation process, but they were emphasized in some interviews. Interviewees preferred distributors that regularly share market intelligence and product development opportunities with the firm. The enthusiasm and aggressiveness of distributors to search for new deals, make contracts, and build relationships with the firm were important for some interviewees. Commitment to development was also important for some respondents. The distributors should be active in defining the development needs to respond to the market and participate in training events organized by the firm.

4.1.2. Marketing capabilities

Marketing capabilities are needed to expand the firm's business in each region. As distributors are local players in the market, they know the situation in the country, who the key actors are, and what products are in the market. Selling the firm's equipment, services, and systems is one of the distributors' key responsibilities. The distributors need to be able to approach the right customers, create interest in them, negotiate with them, understand their needs and requirements, identify opportunities, and prepare a suitable proposal to respond to customers' needs. The capability to manage customer relationships is also very important for the firm as a complex system provider. A distribution director explained, "The required investment in the business is high, and the environmental issues are very important. Thus, there are not many newcomers in our business." As the firm uses its distribution channels to maximize the firm's presence in each region, it is important that the distributors are capable of covering many areas in their territories.

4.1.3. Delivery capabilities

Delivery capabilities are directly related to providing products, systems, and services to customers. Technical knowledge and skills related to the firm's products and processes were very important for the managers. Technical knowledge has a direct effect on distributors' service capabilities. Distributors need to provide suitable services to customers, including repair, maintenance, and provision of spare and wear parts. The distributors are not expected to provide more advanced service packages (such as life cycle services) yet, but this capability should be developed in the future. Although the firm supplies its distributors with standard equipment, fulfilling specific customer requirements requires going beyond the standard machinery and providing customized systems. Systems are combinations of equipment that should be assembled together, balanced, and put in operation, as well as provide the services required to use the system. A distribution director explained, "We are not only selling a standard product on the brochure. This is something that we have to consider." Therefore, capabilities related to analyzing customers' needs, identifying the required equipment, proposing the appropriate process, and preparing proposals are considered important for distributors. The distributors develop the required capabilities for commissioning the equipment and systems over time. The distributors usually need support from the firm the first time they install equipment or complex systems. However, the need for technical support decreases for subsequent orders and projects.

4.1.4. Distributor capabilities in the relationship with the project-based firm

The results show that although all identified capabilities are important for the firm, their importance may differ across the different distributors, and capabilities may emerge and evolve differently depending on the phase of the firm-distributor relationship. Through a further analysis of the interview data, Table 3 categorizes the capabilities into those that are required from the early stages of the project-based firm's relationship with distributors and capabilities that are required to evolve during the relationship.

According to the interviewees, the first group of capabilities are less negotiable, and the firm uses these capabilities as the basis for distributor selection or expect the distributors to acquire the capabilities in the early stages of the relationship.

Table 4
Summary of identified distributor integration mechanisms.

Integration mechanism	Description	Mechanism type
Project-level integration mechanisms		
Joint customer visits and meetings	Joint initial negotiation with customers	Cooperation-oriented
Support in developing proposals	Cooperate in preparing technical and financial aspects	Cooperation-oriented
Joint commissioning	Provide resources and on-site training for new systems	Cooperation- and development-oriented
Support for service business	Provide resources and on-site training	Cooperation- and development-oriented
Business-level integration mechanisms		
Evaluation of distributors	Annual evaluation of distributors based on specific criteria	Control- and development- oriented
Monitoring of distributors	Regular monthly or quarterly	Control- and development- oriented
Integrative ICT tools	Extranet portal to access business documents and tools	Control-oriented
Trust-building	Knowledge and information sharing	Cooperation-oriented
Informal activities	Day-to-day support through email, phone, and meetings	Cooperation-oriented
Training program	On-site training, classroom training, and e-learning	Development-oriented
Development of suitable organization	Finding and structuring suitable resources	Development-oriented
Shared offices for development activities	Irregular, temporary colocation with distributors	Development-oriented

This means that for new distributors, business capabilities, marketing capabilities, technical knowledge of products and processes, as well as enthusiasm, aggressiveness, and commitment to development, are particularly important, if they want to develop a relationship with the project-based firm. A distribution director explained the high importance of basic capabilities, such as good market coverage in his region: "The country is completely different, and we have an accessibility problem, due to safety issues. In this case, we want to find a distributor that is fully self-independent with the right coverage."

Delivery capabilities for complex systems or commissioning and start-up are more important in areas that have more developed and experienced distributors than new distributors. This also implies that the project-based firm can use more experienced distributors for more complex and potentially service-intensive project deliveries. For example, a distribution director explained, "First, they need to learn about our products and processes. Then later, they can face more complex systems."

Relational capabilities, such as sharing market intelligence and sharing product development opportunities, can also be affected by the distributors' organizational culture. The interviews revealed that the distributor firms can be very different in terms of operating methods, particularly in the openness and sharing that they are willing to engage in with a manufacturing firm. For example, a distribution director explained, "It is a problem in this area because they are very keen to get information from you, but they are not so keen to give you some feedback or share market intelligence." This kind of sharing is particularly important in novel and complex projects, and the distributors' cultures may differ in how they support the required relational capabilities for such projects.

4.2. Distributor integration mechanisms

In contrast to the traditional viewpoint that looked at distributors as customers that could add some sales volume, the firm wants to have professional local partners. To achieve this goal, the firm tries to develop relationships with its distributors. The interviewees explained several actions that their teams perform to integrate with distributors. Table 4 presents the summary of these actions. Some actions are more at project level, and other actions are at business level.

4.2.1. Project-level integration mechanisms

Experienced distributors do not usually require support for standard systems. However, when the distributors are involved in more complex projects, the distributors need support from the firm's distribution management team. A distribution director explained, "The more complex the project, the less independent the distributor." Concerning project-level integration mechanisms, the emphasis was on cooperation- and development-oriented activities. Working together during projects provides an environment for cooperative activities and knowledge sharing. The relationship between the firm and its distributors is less dependent on formal roles and structures but more focused on interaction between actors, learning, and developing in real cases. For example, the distribution management team needs to organize several joint visits to the factory and to the customer's site and provide an opportunity for the distributor to meet specialists of the case company and discuss the whole system or its parts. A distribution director explained, "So, it is not only the supplier–customer relationship. It can be far more than that." Fig. 1 shows the system delivery process and the roles of different players in each phase.

Most of the time, the distributors are the main contact point for inquiries about new projects from customers. The main negotiation with customers is done by the distributors. However, the distribution management team can provide support at this stage by accompanying distributors in the initial meetings with customers. Then, the distributor starts preparing the proposal. They usually need support from the distribution management team during this phase, especially regarding technical aspects of the potential project. A distribution director

explained, "At certain points, they will need us to check the process or even to propose the process or to double-check if the process is ready to propose to the customer." The distribution management team may also help distributors regarding financial issues. A distribution director explained, "Right now, the business is very difficult. Sometimes, we help them to make special payment conditions or pricing conditions."

Then the distribution manager or director transfers the customer's request to one of the firm's factories to discuss the proposal and modify it, if needed. The final proposal is delivered to the customer through the distributor's channel. After the customer has accepted the proposal, the system is designed and developed by the case company's factory. Distributors do not usually have an active role during these phases, and the distribution management team acts as the contact point for handling related issues. A distribution director explained, "In most cases, they do not interfere with the design, except to make sure that some details of the proposal are met."

Finally, the system is delivered to the customer's site by the distributor. During the commissioning phase, the firm usually provides resources for more complicated projects. The head of distribution explained, "When a new piece of equipment or a complicated system is delivered in a region, we would send specialists to commission it and to educate the distributor so they can commission it the next time."

After-sales services are an important part of the distributors' portfolio. One of the important reasons that increases the importance of providing services to the customer is related to the number of potential customers: The number of customers that buy these complex systems and machinery is limited. A distribution director explained, "So, by force, the distributors have to be strong on the service side. When you sell the equipment, then you have to service it because customers will not buy new equipment from you, unless you are able to provide services and support them." The firm provides customized equipment and systems that differ in size, model, design, and applications. Thus, service processes vary for complex machinery, and distributors do not necessarily have all the required knowledge and skills to maintain these systems. The distribution management team needs to support the distributor in these complicated cases by providing service specialists and developing distributors by providing on-site training at the customer's site. However, improving the service business occurs not only by developing service capabilities among distributors. Thus, the firm also tries to improve the service organization in the distribution management team. The team should have at least one dedicated specialist for service business. A distribution director explained the reason: "We need to be sure that the distributors have good support, good training, and good vision for selling services."

4.2.2. Business-level integration mechanisms

Business-level integration mechanisms consist of several control-, cooperation-, and development-oriented integrative activities. Various continued control-oriented activities were emphasized in the interviewees' experiences for business-level integration. The distribution managers evaluate the distributors in the given region annually based on the goals that were set for the distributors. The evaluation criteria include service capability, financial stability, past performance in terms of sales and claims, warranty claims, customer feedback, etc. The distribution managers in cooperation with the distributors also prepare the business plan for the next year. During the year, the distribution managers perform monthly or quarterly reviews to compare the distributors' performance with the defined targets, identify any issues, and perform corrective actions. Information and communication technology (ICT) tools play an important role in the global distribution network. The firm provides distributors with an extranet portal to help them price the equipment and spare parts, access technical data and product information, have sales presentation materials and documentation, and process warranty claims.

The interviewees emphasized the importance of building a relationship with distributors and improving the distributors' trust in the firm. For example, the firm is promoting life cycle services as part of their system delivery. The distributors are not very active in offering these services to customers, yet. A distribution director explained: "It is an investment that they should do, but then the return on investment can be long. They need to be sure that the business is profitable." The distributors need to be educated about the potential profit they may lose by ignoring this business. To improve awareness, the firm's global analytics team provides analytic reports about potential business in each region. The distribution management teams try to have a close relationship with distributors. The teams provide day-to-day support through email, phone, meetings, campaigns, and seminars to be sure that the distributors are updated about the latest news on new products and services, and they have the same concepts about those offerings and are able to promote them.

While the firm tries to develop distributors by close cooperation and integrative teams in each project, the interviewees also emphasized the use of organized training programs. Analyzing the distributors' capabilities and investing in developing the distributors are among top priorities for the case company. The head of distribution explained, "When you have an external distribution network, then the network gives you significant cost savings compared to a direct sale. Thus, some of those cost savings have to go into training and developing the distributors." The training program is one of the important deliverables of the distributor evaluation process. A distribution director explained the training program: "It is a long process. They need to be developed in three main areas, including sales and marketing, technical training, and after-sale services." The training program includes different levels and topics and training at the distributors' sites and at the case company's factories. *E*-learning is an effective tool that saves costs and provides comprehensive training materials for different equipment and services. In addition to the training program, the distribution management team helps less-developed distributors find the right people and create a suitable organization. The team also tries to spend some time in the distributor's organizations to know the real business issues and develop the distributor's capabilities.

5. Discussion

5.1. Distributors' required capabilities for delivering complex systems

The first research question dealt with the requirements of a project-based firm for distributor capabilities in delivering complex systems. We offer an initial framework for future research on the required distributor capabilities in complex system delivery (Table 2). The result shows that different capabilities are expected from distributors: business, relational, marketing, and delivery capabilities. Some capabilities could belong to more than one category and affect other capabilities; the categorization helped the researchers build a holistic view of the distributors' required capabilities.

The empirical findings complement previous research on high-volume manufacturing firms by identifying capabilities and offering empirical illustrations directly related to the delivery of complex systems and services, which is particularly central for project-based firms. Although all capabilities are required for a successful business for the project-based firm and the distributors, some capabilities are more directly connected to system delivery, including marketing and delivery capabilities. Both types of capabilities were emphasized in the interviews with the project-based firm's staff, and they offer a more elaborate idea of the nature of the capabilities, compared to the term "technical capabilities" that was suggested based on previous research in other contexts. The results support previous studies on distributor selection regarding the high importance of technical knowledge and skills (Cavusgil et al., 1995; Lin and Chen, 2008) but also draws attention to the process competences needed in delivery capabilities. A project-based firm requires distributors that are capable of understanding customers' specific needs and delivering the required systems. A project-based firm also requires delivery of high-quality services that complement the project delivery and add value for customers during discontinuity between projects (Kujala et al., 2013).

The results of the case study contribute to previous research by confirming the importance of marketing capabilities (Cavusgil et al., 1995; Lin and Chen, 2008; Zou et al., 2011) and suggesting more emphasis on marketing capabilities, especially regarding customer relationship management due to the discontinuous nature of the project-based firm's business (Cova and Salle, 2005). The present results highlight that project-based firms need distributors that can go beyond the standard products and are capable of understanding customers' specific needs and requirements, prepare suitable proposals to respond to those needs, and persuade customers to buy the systems from the distributors.

The results support the literature by showing that project-based firms require distributors that are committed to developing their relationship (Kaleka, 2002; Lin and Chen, 2008) and have a stable business level (Cavusgil et al., 1995; Zou et al., 2011). In general, relational capabilities and business capabilities are independent of certain projects, but these capabilities were identified as the basic requirements for distributors to develop the relationship and run the business.

This study contributes to literature on organizational capabilities by complementing previous research on developing project capabilities in project-based firms. Literature has mainly discussed developing the required capabilities within project-based firms (Davies and Brady, 2000). Not enough focus has been placed on how other actors can learn from the projects and build organizational capabilities to support the business of the project-based firm. The project-based business increases the complexity of the capabilities required for distributors as distributors no longer sell standard products, but the distributors face new customer requirements that need new solutions and subsequently, a new set of capabilities. However, project-based firm with ETO manufacturing may repeat the new solution in other similar projects but with varying complexity. This characteristic increases the importance of learning from project to project also for the partners of the project-based firm.

The results show that although some capabilities are required in the beginning of the relationship (such as business capabilities), other capabilities may develop over time, during the relationship and various projects, offering supportive evidence to previous research (Cheung and Rowlinson, 2011). Evolution of capabilities through the relationship of the case company and the distributors validate the bottom-up, project-led phases of organizational learning (Brady and Davies, 2004). Capabilities such as delivering complex systems develop through learning from delivering the first kind of system and gradually become organizational capabilities of distributors.

Business-led learning through top-down strategic decisions (Brady and Davies, 2004) have not been observed in the relationship with distributors previously, mainly due to the independence of distributors as separate organizations. This organizational separation makes refocusing the strategy on new required project capabilities very difficult, if not impossible. However, the findings highlight the important role of a project-based firm's training service as a top-down approach to developing the required capabilities in distributor firms. Altogether, the interviewees did not expect to find a distributor that has all types of capabilities to start with, but they expect to have distributors that are committed to developing and accepting the main roles in selling and delivering systems in the distributors' specific markets, and learning from experience.

5.2. Distributor integration in project-based firms

The second research question inquired into how a project-based firm integrates distributors in the delivery of complex systems. This research has contributed by shedding light on the role of distributors as intermediaries between a project-based firm and its customers. Literature has, in general, discussed direct relationships with customers and emphasized the benefits of customer involvement (Dvir, 2005; Hsu et al., 2011; Kim and Wilemon, 2002). Previous research suggested that the discontinuities between transactions in project-based firms increase the importance of building and maintaining relationships with customers (Pinto and Rouhiainen, 2001). The findings open up the new topic of the role of distributors in the project sales channel. The role of distributors extends

beyond a single project: They have a direct connection with customers, they can create repeat project business, and thus, they have a more stable role in the project-based firm network.

Integration, in this case, was demonstrated as a continuous set of activities, roles, and tools that are not limited to executing the project. The findings reveal 12 mechanisms that project-based firms use to integrate with distributors and categorize the mechanisms using two dimensions: the type of mechanism (control-, cooperation-, and development-oriented) and the usage level (project- or business-level mechanisms). This study adds to previous research through showing that project-based firms utilize various development actions to integrate distributors in their business. Previous studies on supplier integration identified several control- and cooperation-oriented integration mechanisms (Eriksson, 2010; Martinsuo and Ahola, 2010; Taylor et al., 2015), while also acknowledging development orientation as part of cooperation. The present results demonstrate that the stable position of distributors in the network require the project-based firm go beyond control- and cooperation-oriented mechanisms and implement a long-term plan to develop the required capabilities in the distributors, surpassing those required for marketing and selling standard products.

The results emphasize the importance of project-level integration mechanisms and show that distributors have active roles in the initiation, delivery, and after-sales phases of projects. However, the study results suggest that distributor integration is not limited to certain transactions or system deliveries but also occurs during the discontinuity between projects (business-level integration). Fig. 2 maps the integration mechanisms in these two defined dimensions and offers a novel framework for future analytical purposes. In practice, some of the integration mechanisms could belong to more than one category.

At the project level, delivering complex systems requires close interaction of the project-based firm and the distributor for continuous sharing of knowledge and working together during the project life cycle. The firm uses the temporary duration of a system delivery as a learning environment for distributors. Thus, during system delivery, the project-based firm has a cooperation- and development-oriented approach to the relationship. The majority of previous research on supplier integration focused on integration mechanisms during project execution (Aloini et al., 2015; Cheung and Rowlinson, 2011; Fulford and Standing, 2014; Martinsuo and Ahola, 2010; Pala et al., 2014; Taylor et al., 2015). Our findings show evident differences in the nature of distributor integration compared to supplier integration, in terms of the low appearance of control-oriented integration. It is possible that this stems from the active business-level, control-oriented integration setting the foundations for effective project-level cooperation and development.

At the business level, different approaches are taken by a project-based firm to cooperate with distributors, control their performance, and identify improvement areas in the distributors' capabilities and develop them. In comparison with control-oriented mechanisms in supplier integration (Martinsuo and Ahola, 2010), defining goals, structures, guidelines, or monitoring is not limited to single projects but happens at the business level and has a close connection to development-oriented mechanisms. Where previous research has pointed out the usefulness of business-level mechanisms for utilizing the innovation potential of suppliers in construction projects (Sariola, 2018), our study shows that the business-level integration mechanisms may be used to build basic routines that enable the independence of distributors and their fluent cooperation and development with the project-based firm during projects.

The type of integration mechanisms used at the project level and business level can vary across distributors. Although the result lends support to previous research concerning supplier integration in that different relationships require different combinations of integration mechanisms (Martinsuo and Ahola, 2010), we reported novel evidence particularly concerning how integration can be used to develop the project-based firm's relationship with its distributors. A previous study on supplier integration pointed out the temporal duration of the relationship and discontinuities between projects as important factors affecting the type of integration mechanisms used (Martinsuo and Ahola, 2010). Although the relationship duration increases through repetitive projects in ETO manufacturing, distributor integration requires that the relationship is retained and even strengthened during discontinuities, which is not compulsory in supplier integration. In fact, the distributors' customer interface role during discontinuities (i.e., project sales and services) makes them quite different from suppliers as integration partners for the project-based firm. This study suggests that the repetitiveness of projects over time and the distributors' customer interface role together can enable the differentiation between project- and business-level integration mechanisms and that the business-level integration mechanisms (e.g., control-oriented) may enable a certain kind of project-level integration approach (e.g., development- and cooperation-oriented). Thus, the findings draw attention to the evolving relationship between project-based firms and distributors, and suggest differentiation and proactive improvement of the integration mechanism package over the life cycle of the distributor relationship.

6. Conclusion

This paper contributes to research on inter-organizational relationships particularly concerning project-based firms and their distributors in project business. We identified several distributor capabilities and categorized them into business, relational, marketing, and delivery capabilities, thus contributing to research on organizational capabilities required in inter-organizational project business. We showed that marketing and delivery capabilities become important when the firms are involved in complex system delivery. The study also shows the complexity of the required distributor capabilities in project-based firms. By categorizing capabilities into those that are required from the early stage of the distributor relationship and those that evolve during the relationship, the study highlights the dynamism in distributor capabilities. In particular, the

capabilities related to complex system delivery develop through learning during the repetitive collaboration across projects and become part of the distributors' organizational capabilities.

The paper highlights the role of distributors as central stakeholders in the milieu of project-based firms and points out the actions required to enhance integration in the project business. By analyzing the relationship between a project-based firm and its distributors, we identified several integration mechanisms and categorized them into project- and business-level mechanisms, as well as control-, cooperation-, and development-oriented mechanisms. The study shows a very different approach to integration mechanisms concerning distributors, compared to previous research concerning suppliers. The stable position of distributors in the downstream value chain facilitates the use of integration mechanisms at the business level, in addition to mechanisms at the project level. This characteristic and the repetitiveness of projects in ETO manufacturing highlight the role of a development-oriented integration approach in the projects over time, which deviates clearly from the control orientation in supplier integration stemming possibly from separate competitive tendering for each project.

The empirical findings suggest different configurations of integration mechanisms for different distributors in terms of their stage of relationship with the project-based firm, which paves the way for further research. The case study offered evidence for how distributor capabilities evolved from the early relationship toward readiness for more complex systems, and at the same time, the discontinuities between projects and repetitiveness of new projects enabled the project-based firm to use business-level integration mechanisms. The findings point out possible links between distributor integration and capability, and emphasize the project-based firm's needs for and important role in developing the maturity of the distributor relationship.

The focus on a single case limits the generalizability of the findings, and broader sample studies are suggested to confirm and expand the findings. Capabilities and integration mechanisms can depend on the context of the industry and the type of project. Thus, further research is required to understand how distributor integration mechanisms differ across regions, contexts, and project types, how these mechanisms affect distributor capabilities, and how the distributor relationship evolves over time.

The study took the project-based firm's perspective and used interviews with the focal firm's staff. Further research is required to investigate the distributors' perceptions of the expected capabilities and efficiency of integration actions. The finding creates an initial framework for future research on distributor capabilities and integration. The frameworks could be utilized in quantitative studies, as well as managerial toolboxes in distributor assessment and development.

This study directs attention to the downstream of the value chain in a project-based firm. Further research is required to demonstrate the differences between the positions of different actors in the project network and subsequently, the different integration mechanisms that need to be implemented by a project-based firm. Moreover, distributors are used as substitute for internal sales organizations. We suggest further research to compare distributor capabilities and a project-based firm's internal sales channel capabilities.

Further research is also required to design the appropriate structure and the creation of new roles in the project network to facilitate the coordination of the relationship. The initial findings of the current study identified three roles in the project-based firm, including a strategic planning team or person who sets the goals and criteria and monitors the distribution network, a regional director who evaluates the distributors' performance and provides specific development plans, and a direct manager who performs day-to-day cooperation with the distributors. More research is required to understand the governance of the project-based firm's distributor relationships.

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Integrating services into solution offerings in the sales work of project-based firms

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