THESIS FOR THE DEGREE OF LICENTIATE OF ENGINEERING

Managerial Challenges in the Development of Integrated Solutions

SIRI JAGSTEDT

Department of Technology Management and Economics

CHALMERS UNIVERSITY OF TECHNOLOGY

Gothenburg, Sweden 2016

Managerial Challenges in the Development of Integrated Solutions
SIRI JAGSTEDT

ISSN 1654-9732
Technical report no L2017:083

Department of Technology Management and Economics
Chalmers University of Technology
SE-412 96 Gothenburg
Sweden
Telephone + 46 (0)31-772 1000

Printed by Chalmers Reproservice
Gothenburg, Sweden 2016

Managerial Challenges in the Development of Integrated Solutions

SIRI JAGSTEDT
Department of Technology Management and Economics, Chalmers University of Technology

Abstract

The purpose of this thesis is to investigate managerial challenges related to the development of integrated solutions. This purpose is in line with a trend towards moving into solution provision in manufacturing, and the complexity that arises in the development of so called integrated solutions compared to the development of physical products. Integrated solutions can be described as products and services integrated to create a value surplus associated to the customer's operations. That is, when services are not simply added to the product and can be treated separately, but rather are provided as an integrated solution to a customer problem to facilitate or optimise their operations. While challenges related to servitization have been identified, companies are struggling with the development of integrated solutions. Those integrated solutions put new demands on the development organisation and raise several challenges, which have to be managed. This thesis are concerned with these. The thesis addresses two research questions. The first research question is 'How can integrated solutions be described?' which relates to what needs to be developed. The second research question refers to the implications for the product development organisation and is formulated as 'What are the implications for the product development organisation when a manufacturing company moves into provision of integrated solutions?'

Three studies were conducted, based mainly on data collected via interviews with managers working on the development of integrated solutions. The first study investigated effects on the product development of a manufacturer moving into provision of integrated solutions. The second study investigated how various dimensions can be used to describe different integrated solutions. The third study explored how platform thinking applies to the development of integrated solutions.

The thesis concludes that there are managerial challenges involved in the development of integrated solutions related to the co-existence in the same company of different integrated solutions. There are challenges also associated to integration in the development of integrated solutions, and the need to balance customisation and standardisation. In addition, manufacturers are required to utilize and care for their product and technology knowledge, which add to the complexity of the development.

Key words: Integrated solutions, servitization, solutions development, integration, managerial challenges, product-service offerings

List of appended papers

Paper 1: Jagstedt, S., Persson, M. and Lindlöf, L. (2015), "Moving into integrated solutions: effects on the product development"

The paper was presented at the 16th International CINet Conference, September 2015, Stockholm, Sweden.

Contribution: Jagstedt was the lead author, initiated the study, collected the data, conducted the analysis and wrote the paper. Persson and Lindlöf contributed with support and improved the structure of the paper.

Paper 2: Jagstedt, S. and Persson, M. (2016), "Describing different integrated solutions", under review in an international journal.

An earlier version of the paper was presented at the 4th International Conference on Business Servitization, November 2015, Madrid, Spain.

Contributions: Being the lead author, Jagstedt initiated and designed the study, collected and analysed the data and wrote the paper. Persson contributed with guidance, support and improvements of the paper.

Paper 3: Jagstedt, S. and Persson, M. (2016), "Platform thinking in the development of integrated solutions"

The paper was presented at the 17th International CINet Conference, September 2016, Turin, Italy.

Contribution: Jagstedt was the lead author of the paper and contributed most of the writing. Jagstedt, and partly Persson, designed the study, collected the data and conducted the analysis.

Acknowledgements

Despite my name being the only one on the cover of this thesis, this is not a result of a one-woman effort. Without help, support and guidance from a number of people, this thesis would never have been achieved. I want to express my gratitude to some of those people before introducing my research topic.

Warmest thanks go to Magnus Persson, my main supervisor, for giving me the opportunity to become a PhD student, and for inexhaustible patience. I thank you for always being supportive, for helping me to achieve order out of chaos, and for calming me down when needed. To my co-supervisor, Ludvig Lindlöf, thank you for your positive spirit, guidance and encouraging comments. You two are a great team!

I am grateful also to the companies and people participating in the studies. Thank you for giving me access and insights into your companies and business. Without your participation, there would have been no research to write about.

I am grateful for my inclusion in the department of Technology Management and Economics, and want to thank all my department colleagues; in particular, I want to thank current colleagues in the division of Innovation and R&D Management, and former colleagues in the division of Operations Management. I am grateful also to all the PhD students with whom I really enjoyed discussions, coffees and lunches. Special thanks to Hanna Rydehell for well-needed breaks with laughs, coffee, snacks and chocolate.

I have had almost two enjoyable years since starting as a PhD student; and were it not for Nina Edh Mirzaei, I probably would not have embarked on the PhD study. So, Nina, thank you for introducing me to the PhD student opportunity, for sharing your experiences and for being a mentor in the quite confusing research-land.

A special thanks also to my family. Simon, thank you for your loving support and for your encouragement. Thank you for listening to me when talking about my research over and over again, thank you for taking care of me and for being the best. I love you.

Mamma, Pappa, Anders, Brita, Erik, Ellen, Malin, Jacob, Jan, Kerstin, Sebastian, Mormor, Farfar, Tore and Gittan – what would I have done without you? Thank you for always reminding me of what is important and thank you for being you.

Table of content

1. Introduction

This thesis is about managerial challenges related to the development of integrated solutions – integrated combinations of products and services addressing customers' overall operational needs. The first chapter introduces the thesis, including the background to the research and discussion of the problem.

1.1.Background

Manufacturing companies increasingly are integrating services with their physical products in order to create a more valuable offer and gain competitive advantage in a global market (Baines et al., 2009; Vandermerwe and Rada, 1988; Wise and Baumgartner, 1999). This move to add services has been described as 'servitization', which is changing how companies operate and provide value (Vandermerwe and Rada, 1988). The move to servitization is leading to the development of new business models including various kinds and degrees of services. To create possibilities for growth beyond the product base, and to create a value surplus, the adoption of an integrated product-service business model has been proposed (Visnjic Kastalli and Van Looy, 2013). Integrating products and services into a seamless offering to address a customer's overall operational or business needs (Davies, 2004; Storbacka, 2011; Wise and Baumgartner, 1999), is described as an 'integrated solution'. By providing integrated solutions, companies aim to capture profits from downstream in the value chain (Wise and Baumgartner, 1999), and to create a value surplus associated to the customer's operations and outputs (Brax and Jonsson, 2009; Windahl, 2007). Wise and Baumgartner (1999) demonstrate the rationale for moving downstream by discussing the distribution of revenue in the locomotive industry, the automobile industry and the personal computer sector, where the revenue from initial product sales accounts for less than 20% of the potential revenues over the product life-cycle (Wise and Baumgartner, 1999). The remaining potential revenue is represented by the services associated with the products' overall life-cycles. Manufacturers should therefore move beyond products and to add and integrate services. By adapting an integrated product-service business model, such as integrated solutions, some of this potential revenue can be captured by the manufacturer, and growth beyond the installed base of products is enabled (Visnjic Kastalli and Van Looy, 2013; Wise and Baumgartner, 1999). When moving into provision of integrated solutions companies are not simply focused on increasing the service component of their offering. It goes beyond bundling and combining (Davies, 2004; Nordin and Kowalkowski, 2010) and involves integrating products, services and knowledge into an overall offering creating a value surplus, which addresses the customer's business or operational needs and problems (Brax and Jonsson, 2009; Davies, 2004; Storbacka, 2011). The solution might for example be designed to handle some parts of the customer's operations (Davies et al., 2006), enabling the manufacturer to capture revenues from the customer end of the value chain (Wise and Baumgartner, 1999).

The integrated aspect of integrated solutions is what makes the difference compared to other offerings (Davies et al., 2007; Johansson et al., 2003), but the complexity of the development of integrated solutions is increasing compared to the development of physical products (Windahl, 2007, 2015). This requires closer collaboration among organisational functions within the company and with external parties (Parida et al., 2014; Windahl et al., 2004; Windahl and Lakemond, 2006). The importance of a customer focus has been emphasised frequently and it is generally agreed that companies moving into integrated solutions need to be more customer-oriented. It has been argued also that a move into solution provision changes the customer relationship from being transactional to relational (Oliva and Kallenberg, 2003), and has implications for the organisational functions involved.

The rationales and opportunities for moving into integrated solutions have been highlighted (Wise and Baumgartner, 1999), but servitization is risky and many companies fail to achieve the benefits aimed for (Benedettini et al., 2015; Brax, 2005). Hence, the challenges involved should not be underestimated (Davies et al., 2006). It has been argued also that the higher the degree of integration, the greater the implications for the organisation in terms of solution design and delivery (Martinez et al., 2010). However, this is an area that has not been thoroughly investigated. It is further argued that how to innovate solutions needs more attention in research (Evanschitzky et al., 2011), including problems associated with developing integrated solutions.

1.2. Problem discussion and purpose

While manufacturers are interested in exploring the opportunities downstream (Wise and Baumgartner, 1999) and should consider to adopt an integrated product-service business model (Visnjic Kastalli and Van Looy, 2013) such as integrated solutions, they need also to expect managerial problems associated to the development of these offerings. This applies especially to the integration of products and services and not those associated only with an increased service content, which is the focus of most existing research. Many companies fail to achieve the hoped for benefits, and it is acknowledged that previous research tends to focus on success stories rather than investigating the experiences and difficulties faced by manufacturers (Johnstone et al., 2009).

When a manufacturer moves into solutions provision, its development strategies are challenged (Shepherd and Ahmed, 2000) as the complexity in development increases (Windahl, 2007, 2015). Development no longer concerns the development of services and products independently, it involves their integration (Parida et al., 2014). This complexity brings challenges which have to be addressed by managers, especially considering the potential competitive advantages manufacturers have related to their products and the

development (Ulaga and Reinartz, 2011; Wise and Baumgartner, 1999). These problems could be described as managerial challenges.

Previous research argues that the transition to a solution-oriented business model is difficult (Brax, 2005; Martinez et al., 2010), and identifies several problems including culture, relationships with customers, internal processes and integrated product-service design (Baines et al., 2009; Brax, 2005; Martinez et al., 2010) among others. However, despite the complexity involved in developing solutions and the fact that solutions provision requires intra- and inter organisational coordination (Matthyssens and Vandenbempt, 2008; Windahl and Lakemond, 2006), few studies examine the problems related to the development of offerings. By this we mean the internal processes and the integrated product-service development in particularly in relation to provision of integrated solutions with a high level of integration among components. In order to adopt an integrated product-service business model such as proposed by Visnjic Kastalli and Van Looy (2013), the managerial challenges associated to the development of the integrated solutions require further examination. Previous research identifies the problems related to the transition; the present thesis investigates the complex and demanding development of integrated solutions. The purpose of this thesis is hence to investigate managerial challenges related to the development of integrated solutions.

1.3. Thesis outline

The thesis starts with a short introduction and background to the phenomena investigated in this thesis. Chapter 2 reviews previous related research, and includes a short presentation of the topic of servitization, followed by a summary of combinations of products and services with a focus on integrated solutions. Lastly, it formulates the research questions. Chapter 3 presents the research methodology, the research design and the research process and describes the case companies. Chapter 4 provides short summaries of the appended papers and outlines their relevance. Chapter 5 discusses the findings and the contributions of the thesis. Chapter 6 provides a summary, conclusion and suggestions for future research.

2. Frame of reference

Integrated solutions are integrated sets of products and services addressing customer overall needs. After describing products, services and their distinction, a discussion of servitization, being the movement of offering more solutions and services is provided. Section 2.3 presents various forms of product-service combinations, before focusing on the concept of integrated solutions in 2.4. Section 2.5 discusses the development of integrated solutions in manufacturing companies. Section 2.6 last in the chapter presents the research questions.

2.1. Products, services and their distinction

Traditionally, a product is described as an artefact made or manufactured for sale in a market (Collin, 2006, p. 316; Rathmell, 1966) and services are considered as everything else apart from goods – e.g. intangible actions or processes (Rathmell, 1966; Zeithaml et al., 1985). The word service is usually used as verb, while the word product is a noun (Rathmell, 1966). The concept of services is generally perceived as 'fuzzy' (Edvardsson et al., 2005).

Historically services were defined as intangible, heterogeneous, inseparable and perishable, or IHIPs (Zeithaml et al., 1985). Intangibility refers to the fact that they cannot be touched, seen or felt (Zeithaml et al., 1985), and are not objects, but rather are a performance or activity (Rathmell, 1966; Zeithaml et al., 1985). Further, service providers and processes are heterogeneous (Edvardsson et al., 2005). Due to the variation in customers' expectations and in the individuals delivering the service (Edvardsson et al., 2005; Zeithaml et al., 1985), the production of services by the same company is also heterogeneuous. Inseparability refers to the simultaneous consumption and production of a service, resulting in the impossibility to save or store it since it is a performance – that is, it is perishable (Zeithaml et al., 1985).

However, these descriptions have been criticised on several counts. For example, because they are seen as being based on the producer's and deliverer's perspective (Edvardsson et al., 2005), rather than being related to the value for the customer (Vargo and Lusch, 2004b). Edvardsson et al. (2005) identify two approaches to services - one focuses on a service as a market offering, and the other views service as a perspective of value creation (Edvardsson et al., 2005). The authors propose also that the second perspective of the service as a perspective of value creation from the customers' viewpoint is more useful, including focusing on the value through the customer's perspective (Edvardsson et al., 2005). Vargo and Lusch (2004a, 2004b) offer a similar viewpoint, arguing that people do not enter into an exchange in order to acquire a product or a good, but rather to gain from each other's knowledge. That is, a service is conceptualised as a process, being the basis for an exchange (Vargo and Akaka, 2009; Vargo and Lusch, 2004a), rather than as an entity or output. This perspective focuses on the customer as a co-creator of value (Lusch and Vargo, 2014; Vargo

and Lusch, 2004a), rather than on the impossibility to separate the consumption and production of a service (Edvardsson et al., 2005). However, the description of the customer as a co-creator of value has also attracted critique (Grönroos, 2011) based on the argument that development, design and production are not part of value creation itself; value creation depends on the customers' value-in-use (Grönroos, 2011). Value creation is hence perhaps best understood through the lens of the customer and its value-in-use (Edvardsson et al., 2005); that is, the customer is always the value creator, while the providing company rather is, or could be, a facilitator of value creation (Grönroos, 2011) than a creator of value.

In adopting the idea of the company as a facilitator rather than a value creator, this thesis examines development of integrated solutions and not value creation from the customers' viewpoint. Grönroos (2011) points out that value creation is a two-sided process. In order to understand the provider perspective (in this case the development, not the value creation, but rather value facilitation), this thesis considers service as an offering rather than as a perspective of creating value from the customers' viewpoint.

2.2. Servitization

Servitization can be described as the move towards 'increasingly offering fuller market packages or 'bundles' of customer-focussed combinations of goods, services, support, self-service and knowledge' (Vandermerwe and Rada, 1988, p. 314). Through servitization, manufacturers increase their share of business from services. These services can be of various kinds and with more or less focus on the product itself (Baines and Lightfoot, 2013). Services may for example be described as base services, focused on the product provision, intermediate services focused on the condition of the product provided, or advanced services, which are focused capability and, hence, related more to supporting the customer than the product (Baines and Lightfoot, 2013).

While research on servitization has grown since the term was first coined in 1988 by Vandermerwe and Rada (1988), the phenomenon of moving into service provision is not new (Levitt, 1972; Schmenner, 2009). The transition originally was led by companies with new products, but no excellent manufacturing capabilities (Schmenner, 2009).

The servitization rationale

Companies currently are adding and integrating services to formerly product-focused offerings driven by financial reasons and benefits (Baines et al., 2009; Mathieu, 2001b), including capturing profit from the customer's end of the value chain (Wise and Baumgartner, 1999), higher margins and an intention to gain more stable income over time (Baines et al., 2009; Wise and Baumgartner, 1999). Baines et al. (2009) suggest also that marketing and strategic reasons can motivate manufacturers to add services to their offerings. Strategic drivers include competitive advantage from differentiating and barriers to competition

(Vandermerwe and Rada, 1988). Another motivation for introducing services is to defend against increased competition from low-cost countries (Baines and Lightfoot, 2013) since services are harder to imitate due to their intangible nature. Marketing drivers are related to developing long-term relationships with the customers and creating customer loyalty (Vandermerwe and Rada, 1988). It is argued also that customers are demanding more services (Vandermerwe and Rada, 1988) and, therefore, are driving servitization by manufacturers. Mathieu (2001b) describes so called service manoeuvres or service strategies and proposes that the strategic and financial benefits of servitization might differ depending on the intensity and specificity of the service manoeuvres, while marketing benefits appear to be more dependent on intensity (Mathieu, 2001b).

Challenges related to servitization

While there are clear benefits from and rationales for servitization, manufacturing companies that previously focused on products, face various difficulties when undertaking the transition to servitization (Martinez et al., 2010). Servitization involves fundamental changes to manufacturers' way of operating and providing value, and requires investments and the development of new capabilities and skills (Brady et al., 2005; Oliva and Kallenberg, 2003; Ulaga and Reinartz, 2011). Brax (2005) argues that many of the difficulties associated to servitization are linked to manufacturers' traditional ways of working and doing business. The transition includes key categories of challenges such as re-focusing from a manufacturing- and product-oriented culture to an embedded product-service culture, to managing supplier relationships, achieving strategic alignment, developing the required internal processes and capabilities and delivering an integrated offering to the customer (Martinez et al., 2010). While these issues refer to the overall firm, Kindström et al. (2015) identify implications for the sales function, in particular, regarding the function's organisation, roles and competences. Further, Le Meunier-FitzHugh et al. (2011) argue that the sales function becomes a more strategic function since a service-orientation requires more and closer interaction with customers. These issues and implications are related to the front-end organisation[1] and the delivery of the firm's offerings.

The back-end organisation[1] is also affected and the development strategies are challenged (Shepherd and Ahmed, 2000). While services are dependent on customers and markets, it is important to have a strong back-end unit to develop the necessary firm capabilities and resources (Galbraith, 2002; Miller et al., 2002).

Parida et al. (2015) consider the link between global back-end development and market heterogeneity influencing service provision; they conclude that manufacturers need to develop competences to manage

[1]The front-end and back-end of an organisation, or the front-office and back-office, are related to the visibility of the operations (Slack et al., 2013, p. 24-25). The front-end, or the front-office, is concerned with the parts or functions of the organisation that on regular basis meet and interact with the customers (Collin, 2006, p. 171; Law, 2016). The back-end, or the back-office, has low visibility and performs tasks with low customer interaction (Slack et al., 2013, p. 25, 700), and is hence more or less hidden for the customer (Law, 2016).

the interaction between the local units and the global development functions in service development. These capabilities include to develop customer insight in a global context, to integrate global knowledge, to develop global service offerings, and also to develop digitalisation capabilities (Parida et al., 2015)

Servitization and performance

Despite the issues related to servitization, it is argued that manufacturers should consider the opportunities to be derived from moving downstream in the value chain (Wise and Baumgartner, 1999). Reports of financial performance related to servitization are not conclusive and suggest a non-linear relationship (Visnjic Kastalli and Van Looy, 2013; Suarez et al., 2013) and an increased marginal effect when services constitute the majority of the firm's sales (Suarez et al., 2013). It is argued also that servitization needs to be combined with investment in product innovation, which might entail short term losses, but will allow long-term performance benefits (Visnjic et al., 2016). In discussing servitization and performance, Visnjic Kastalli and Van Looy (2013) recommend that companies should adapt an integrated product-service business model. They reason that such a model enables growth beyond the installed product base and creates spill-overs between the services and products (Visnjic Kastalli and Van Looy, 2013).

2.3. Combinations of products and services

In considering interrelations between products and services, several concepts can be applied to describe a combined offering. Several concepts highlight the importance of addressing customer needs by offering bundles of products and services; however, they differ in their focus and what should be included in the offering. Table 1 presents an overview of various concepts describing different forms of product-service combinations.

Table 1 – Concepts of combinations of products and services

Concept	**Description**
Full services	'Based on the industrial service literature, we define full service as "a comprehensive bundle of products and/or services, that fully satisfies the needs and wants of a customer related to a specific event or problem." The concept of full service strategy is clearly related to the concepts of "bundling" and "systems selling".' (Stremersch et al., 2001, p. 2).
Functional products	'In case of a functional product, the user buys the function, not the product (as opposed to conventional product purchase where the customer buys the product and

	uses it). (…) In this case, customers have access to a technology while not owning a machine' (Kumar and Kumar, 2004, p. 314).
Hybrid solutions / Hybrid offerings	'Hybrid solutions – products and services combined into innovative offerings' (Shankar et al., 2009, p. 95).
Integrated solutions	'A third effective business model is to combine products and services into a seamless offering that addresses a pressing customer need' (Wise and Baumgartner, 1999, p. 138).
Operational services	'The move into the field of operational services, which includes taking over an end-user's maintenance or operating organization …' (Oliva and Kallenberg, 2003, p. 170). (Note: Based on a categorization of operational services as a shift in two dimensions – to 'End-user's process-oriented services' and 'Relationship-based services')
Performance-based contracting	'Known as "power by the hour" in the private sector and as "performance-based logistics" (PBL) in defense contracting, it aims to replace traditionally used fixed-price and cost-plus contracts to improve product availability and reduce the cost of ownership by tying a supplier's compensation to the output value of the product generated by the customer (buyer)' (Kim et al., 2007, p. 1843).
PSS - Product-service system	'PSS should be defined as a system of products, services, supporting networks and infrastructure that is designed to be: competitive, satisfy customer needs and have a lower environmental impact than traditional business models' (Mont, 2002, p. 239).
Solutions	'The companies following a solutions strategy bundle their products together and add software and services. These packages create more value than the customers can create for themselves by buying only the stand-alone products' (Galbraith, 2002, p. 194). '… integrated combinations of products and/or services that are unusually tailored to create outcomes desired by specific clients or types of clients' (Miller et al., 2002, p. 3).

All these conceptions are similar in that all refer to a combination of products and services. However, they differ in their focus, how the customer is addressed, and the degree of integration involved. Some refer to the extended responsibility of the supplier compared to simply selling a product (e.g. functional products as discussed by Kumar and Kumar (2004)), including responsibility for the product over its life-cycle. Some conceptions refer to a lower environmental impact through the combination of products and services (e.g. as in the case of PSS described by Mont (2002)). However, not all conceptions focus as strongly on the idea of integration. 'Solutions' have been argued to be a vague and generic concept, including various kinds of offerings (Nordin and Kowalkowski, 2010). Nordin and Kowalkowski (2010) suggest that it is not the bundle of products and services that distinguishes a solution from some other offerings, but rather the integration. This means that the integration is what facilitates the value for the customer more than the sum of the individual components – hence creating a value surplus (Brax and Jonsson, 2009; Nordin and Kowalkowski, 2010). To emphasise the integration aspect, this thesis uses the concept of integrated solutions to highlight that integration provides a way to create a value surplus for the customer. The choice of the concept of integrated solutions to highlight integration, is proposed also by Valtakoski (2016). Also, it has been suggested that companies should adopt an integrated product-service business model, in order to create a value surplus for the manufacturer via spill-overs among products and services (Visnjic Kastalli and Van Looy, 2013), rather than simply adding services to existing offerings as add-ons. Thus, an integrated solution creates a value surplus for both the customer and the supplier.

2.4. Integrated solutions

As previously argued, advanced forms of product-service combinations, which put emphasis on the integration aspect, can be described as integrated solutions (Shelton, 2009; Wise and Baumgartner, 1999). An integrated solution was proposed first as a business model to move downstream in the value chain (Wise and Baumgartner, 1999). Previous research provides some examples of manufacturers that have moved into provision of integrated solutions from a previous focus on products, those include among others; Alstom and Ericsson (Brady et al., 2005; Davies, 2004; Davies et al., 2006, 2007), ABB (Miller et al., 2002; Windahl et al., 2004), Alfa Laval (Windahl, 2007; Windahl et al., 2004), and Nokia (Miller et al., 2002; Wise and Baumgartner, 1999).

It has been argued that companies providing integrated solutions focus on the customer's business and operations rather than their technology needs (Davies, 2004; Windahl, 2007). The integration is used to create higher value and a better outcome than what would be achieved by the components of the solution if delivered individually - it allows a value surplus (Nordin and Kowalkowski, 2010). The integrated solution can be focused on handling the customer's operations, optimising the customer's costs (Brax and Jonsson,

2009; Davies et al., 2006), or solving specific problems (Storbacka, 2011). This implies an extended view of the customer's needs, which includes considering the customer's business and operations.[2]

Meanwhile, in arguing that concept of integrated solutions is appropriate to describe the phenomenon under investigation, it is necessary to consider various categories and forms of integrated solutions as pointed out by Windahl (2007). For example in some integrated solutions, ownership of the equipment and assets belongs to the supplying company; this is described by Windahl (2007), a 'fully-fledged integrated solution' (Windahl, 2007; p. 5). On the other hand, ownership can be split between customer and supplier, in which case the ownership decision might be less obvious (Windahl, 2007).

The concept of integrated solutions

While there are different definitions of integrated solutions, which focus on different aspects, they all refer to a combined set of products and services which allows the firm to assume broader responsibility for the customer's operations. Most attempts to describe integrated solutions highlight the seamless combination of products and services to create a value surplus (Brax and Jonsson, 2009), but knowledge, systems and information also have been highlighted as potential components of an offering that provide additional value for customers (Brady et al., 2005; Brax and Jonsson, 2009; Valtakoski, 2016; Windahl and Lakemond, 2010). Although previous research agrees about several characteristics, there are differing views about how the customer is addressed and what integration really is. One difference in these descriptions is in the level defined. Wise and Baumgartner (1999) define an integrated solution as a business model, while the descriptions of the concept by Davies (2004), Windahl (2007) and Brax and Jonsson (2009) view an integrated solution as a (seamless) bundle or combination of solution components. This latter view opens the way to a discussion about the existence of several different offerings within a company, as proposed for example by Kowalkowski et al. (2015), Windahl (2007) and Windahl and Lakemond (2010). Valtakoski (2016) breaks the concept down even further by defining it as a bundle of knowledge components that make up the products and services. Storbacka (2011) adopts a different perspective, interpreting integrated solutions as processes rather than simply combinations of components.

Table 2 provides an overview of the integrated solutions concept by presenting a set of descriptions of the concept. These are discussed in what follows to identify similarities, differences and development in this concept over time.

[2] Operations refer to the activities or the tasks of running something (Collin, 2006, p. 279). Operations commonly are described as the set of activities that transforms inputs into outputs (Law, 2016), and hence, produce some products or services (Slack et al., 2013, p. 6). In this thesis, 'customers' operations' refer to the activities involved in the customer's business that results in the production of products and/or services.

Table 2 - Descriptions of integrated solutions

Wise and Baumgartner (1999, p. 138)	*'A third effective business model is to combine products and services into a seamless offering that addresses a pressing customer need'.*
Davies (2004, p. 727)	*'... how services are combined with products to provide high-value 'integrated solutions' that address a customer's business or operational needs'.*
Windahl (2007, p. 5)	*'...a combination of physical products or services, or both, plus knowledge are used to provide a specific outcome fulfilling the customers' needs'.*
Brax and Jonsson (2009, p. 541)	*'... a bundle of physical products, services and information, seamlessly combined to provide more value than the parts alone, that addresses customer's needs in relation to a specific function or task in their business system; it is long-term oriented, integrates the provider as part of the customer's business system, and aims at optimising the total cost for the customer'.*
Storbacka (2011, p. 699)	*'longitudinal relational processes, during which a solution provider integrates goods, service and knowledge components into unique combinations that solve strategically important customer specific problems and is compensated on the basis of the customer's value in use'.*
Valtakoski (2016, p. 5)	*'Breaking down the component down to products and services and further into associated knowledge components, the integrated solution can be interpreted as a bundle of knowledge components'.*

The descriptions of integrated solutions provided in table 2 assume that an integrated solution is a combination of solution components. In relation to components, Wise and Baumgartner (1999) and Davies (2004) refer simply to services and products, while some more recent descriptions include knowledge (Storbacka, 2011; Valtakoski, 2016; Windahl, 2007) and information (Brax and Jonsson, 2009) as components of the offering. In terms of the product, Windahl (2007), Brax and Jonsson (2009) and Storbacka (2011) refer to a physical product or good. However, systems also could be considered to be included as components in an integrated solution (Brady et al., 2005). Valtakoski (2016) adopts a knowledge-based view of servitization, and re-conceptualises the integrated solution offering by describing it as a combination of knowledge components.

While it has been argued that an integrated solution consists of *both* products and services (Brax and Jonsson, 2009; Davies, 2004; Wise and Baumgartner, 1999), Windahl (2007, p. 5) says 'physical products *or* services, or both,' rather than stating that it needs to be products *and* services, indicating that an integrated solution can consist of a bundle of products, or a bundle of services, combined with knowledge. This view is not reflected in any of the other descriptions cited above.

An integrated solution represents something beyond the combination of solution components. This is highlighted by Windahl (2007, p. 5) who states that 'Integrated solutions represent more than a variation on the 'mixing and matching' or 'bundling' theme'. Integrated solutions require the integration among components. This integration aspect is essential and sometimes is described as making the offering 'seamless' (Wise and Baumgartner, 1999). Seamlessness refers to the integration of components to the extent that the customer perceives the solution as a single offering rather than a combination of several components. Hence, there is a difference between a combination of components, and an integrated solution. Park et al. (2012) illustrate this by referring to chemistry, and describing an offering as either a mixture of chemical elements, or as a compound. In a mixture, the elements are physically mixed but not joined together chemically. A compound on the other hand, has unique characteristics and behaviours; the components are completely dissolved and cannot be physically separated (Park et al., 2012). An integrated solution complies with this second description.

Although the integrated solutions concept can be argued to highlight the integration aspect of the offering, some of the descriptions start with putting forward the integrated solution as a combination of components, thereafter followed by a description of the integration aspect. Wise and Baumgartner (1999) and Brax and Jonsson (2009) use the word 'seamless' to emphasise this integration, and Storbacka (2011) links it to the process of integrating. Davies (2004) and Valtakoski (2016) are also discussing the integration aspect, while not being explicitly stated in the descriptions of the concept in Table 2.

The provision of an integrated solution implies increased responsibility, and a shift in focus from the product to the customer's usage and processes. Wise and Baumgartner (1999, p. 138) argue that an integrated solution addresses a 'pressing customer need', while Davies (2004) adds that an integrated solution should address operational or business needs. Several authors have suggested revised and extended definitions of integrated solutions, including an attempt to specify the value it involves, relating it to a specific task or function (Brax and Jonsson, 2009), a specific customer outcome (Windahl, 2007), or strategically important problems specific to the customer (Storbacka, 2011). Thus, an integrated solution might deliver value-in-use for the customer by managing or optimising the customer's operations (Brax and Jonsson, 2009; Davies et al., 2006; Storbacka, 2011), or by solving the customer's strategic problems (Storbacka, 2011). The various descriptions are concerned, therefore, with addressing an overall customer need which involves a

broader perspective and responsibility over the life-cycle compared to provision of a product. This long-term orientation compared to the provision of a product allows the solution provider to address these business or operational needs (Davies, 2004), and provide an outcome for the customer (Windahl, 2007) by optimising the customer's operating costs (Brax and Jonsson, 2009).

To address a customer's operations and overall needs requires an understanding of its processes and business. Storbacka (2011) points out that this means that a 'unique' combination of solution components is needed to address individual and specific customer problems. A high level of customisation in an integrated solution is underlined (e.g. Johansson et al., 2003; Miller et al., 2002; Storbacka, 2011) although not always explicit in the definitions. Rather, customisation seems an implicit aspect of the concept that allows individual customers to be addressed, and related partly to the idea of services as being heterogeneous. However, there are debates of whether, what and how much to customise since customisation is costly and sometimes difficult to achieve and carry out in practice (Brax and Jonsson, 2009; Ceci and Masini, 2011). It has been argued that customers do not expect customisation per se but do expect that the solution will be appropriate for their specific needs and processes (Brax and Jonsson, 2009).

2.5.Development of integrated solutions

Most manufacturing companies' development practices and strategies origin from a product-perspective; service provision requires new processes and new organisational structures (Oliva et al., 2012; Oliva and Kallenberg, 2003). To 'break free' from the product culture, the creation of a separate service unit has been proposed (Oliva and Kallenberg, 2003). On the other hand, to provide integrated solutions requires integration capabilities (Davies et al., 2006; Shepherd and Ahmed, 2000), and the overall development is challenged when providing these solutions (Shepherd and Ahmed, 2000), compared to products. In contrast to Oliva and Kallenberg (2003), Neu and Brown (2005) find that integrated business units are more useful than separate service units. They suggest that this might depend on the company's strategy and what the company is developing (Neu and Brown, 2005). It has been suggested also that the move to integrated solutions perhaps should not be seen as a 'transition from products to services' (Johnstone et al., 2009), as such a viewpoint might be inapproprate due to the integration of components rather than a transition into services. Thus, existing proposals related to a transition to services might be inaccurate. Oliva et al. (2012) also point out that the offerings described by Neu and Brown (2005) are closer to integrated solutions. Hence, to develop integrated solutions requires technical, market/business and integration competences and capabilities (Shepherd and Ahmed, 2000). It is further necessary also to balance services and product innovation (Story et al., 2016), which add further to the development complexity (Windahl, 2007, 2015).

The development of an integrated solution involves the combination of products and service and the integration thereof. Park et al. (2012) suggest that offerings integrating products and services may be marketing-oriented or engineering-oriented. While integration of marketing-oriented offerings is performed downstream in the value chain, by sales and customer services, engineering-oriented offerings are integrated during development (Park et al., 2012). Johansson et al. (2003) describe it as commercial or technical integration. Johansson et al. (2003) and Park et al. (2012) describe an integrated solution as an engineering-oriented offering that is integrated technically.

Research has been reported to commonly agree on that a move to provision of solutions affects the firm with effects on the organisation (Velamuri et al., 2011). In general, a strong customer-centricity is highlighted in servitization (Baines et al., 2009) and in line with this, it has been argued that solutions providers should adopt a customer-centric organisation (Galbraith, 2002). Others argue that a balance between service, product and customer logic is required (Brax and Jonsson, 2009; Visintin, 2012; Windahl and Lakemond, 2010) since an integrated solution requires the company to manage all aspects of the solution. To handle the balance between adapting to customers' unique needs and the development of capabilities, a front-end, customer-facing organisation and a back-end organisation are proposed (Galbraith, 2002; Miller et al., 2002).

Moving into integrated solutions also has implications for the relationships with customers, suppliers and internally within the company. Starting with relationships with external partners, previous research shows that the relationships in the network change with the provision of integrated solutions (Windahl and Lakemond, 2006) and includes establishment of long-term relationships and involvement of customers in the development of the solution (Galbraith, 2002; Windahl and Lakemond, 2006). Companies need also to consider intra-organisational activities and the challenges associated with moving into the provision of integrated solutions (Windahl and Lakemond, 2006), including the development of products and services, and incorporation of externally developed products, technologies and services (Davies et al., 2007). These changes have major implications for the firm's internal organisation and to provide integrated solutions, new capabilities and competencies are required (Brady et al., 2005; Shepherd and Ahmed, 2000). In this thesis, the internal organisation is the focus.

Capabilities for providing integrated solutions

As stated, moving into solutions provision requires development of new capabilities (Baines et al., 2009; Brady et al., 2005; Davies et al., 2006). Capabilities for provision of integrated solutions include operational service capabilities, business consulting capabilities, financing capabilities, systems integration capabilities (Brady et al., 2005; Davies et al., 2006), technical competence and knowledge of the customer’s business and market (Windahl et al., 2004). In particular, systems integration has been argued to be a crucial

capability for integrated solution providers (Davies et al., 2007). Although adapting to the customer is essential, it has been highlighted that too much customisation might be difficult to achieve and carry out practically (Brax and Jonsson, 2009). Thus, companies need simultaneously to balance the need for customisation in the front-end of the organisation and standardisation in the back-end of the organisation (Davies et al., 2006). Davies and Brady (2000) suggest that developing repeatable solutions is required for successful integrated solutions provision and to achieve economies of repetition. Ideally, the developed solutions should be repeatable in that sense that they are to be repeated using experience from previous projects to apply also for other customers (Davies et al., 2006). Davies et al. (2006; p. 45) even state that 'Success in integrated solutions depends on how quickly and easily a company can move from unique to repeatable solutions delivery. It is about balancing customization and standardization'. To manage this is an essential capability for the integrated solution provider.

Companies need also to balance and manage the interplay between product and service innovation (Story et al., 2016; Visnjic et al., 2016) in order to deliver integrated solutions. Further, manufacturers should have distinct but balanced service and product cultures to create synergies between them (Story et al., 2016). It has been argued that it is important to approach the customer in a different way when providing solutions, and for the sales force to focus on selling solutions (Salonen, 2011). It has been argued that the sales force plays a strategic role in managing customers and customer knowledge based on their customer-facing interface (Le Meunier-FitzHugh et al., 2011) While it is important to have an effective customer interface, it is also emphasised that the internal operations must be efficient (Salonen, 2011) and aligned to strategy (Alghisi and Saccani, 2015). Manufacturers moving into integrated solutions hence need to develop new capabilities and, also, exploit the resources, capabilities and knowledge associated to their product base.

Core resources of manufacturers

Following Wise and Baumgartner (1999) it has been argued that manufacturers have competitive advantages related to their products in the move into integrated solutions. There are also other resources that can be considered core to the development of integrated solutions. In the resource-based view of the firm, which argues that resources can generate sustained competitive advantage (Barney, 1991; Wernerfelt, 1984), Eloranta and Turunen (2015) identify three core resource categories described in the previous literature related to servitization; the installed product base, service-enhanced relationships, and complex product-service offerings. By being valuable, rare, inimitable and not substitutable (Barney, 1991), resources could provide competitive advantage, and managers should therefore look within the firm to identify and take advantage of these resources (Barney, 1995). The product base, service-enhanced relationships and the complex offerings provided can be argued to be such resources of manufacturers in servitization (Eloranta and Turunen (2015).

Integrated product-services are difficult for competitors to imitate (Eloranta and Turunen, 2015). This is due in part to the customisation aspect of the offering, but also is related to the knowledge associated with the components and their integration. The provision of offerings supporting the customer, rather than the provision of products, acts to differentiate the market actors (Mathieu, 2001a). The changed relationships between customer and supplier, but also between various actors in the network have been discussed in the context of integrated solutions (Windahl and Lakemond, 2006). These service-enhanced relationships can be considered as resources for solutions providers (Eloranta and Turunen, 2015), and require the customer-supplier relationships to be managed and used to achieve competitive advantage.

For manufacturers, in particular, the installed product base is associated to technology and product knowledge (Oliva and Kallenberg, 2003; Wise and Baumgartner, 1999). Manufacturers also have resources connected to the development and usage of their products (Ulaga and Reinartz, 2011), which allow creation of valuable and hard-to-imitate solutions. These resources and capabilities need to be considered in the development of integrated solutions, and in the move from provision of products to provision of solutions.

Impact of the product base

As already discussed, manufacturers have valuable assets linked to their product base (Wise and Baumgartner, 1999) and the associated knowledge (Ulaga and Reinartz, 2011), which pure service providers lack. The product base and existing capabilities are important when moving into provision of integrated solutions. Despite the transition with needs for new competences, many manufacturers continue to emphasise their product operations while adapting to a solutions orientation (Salonen, 2011). In addition, it has been argued that technology plays an important role in the creation of competitive advantage (Neu and Brown, 2005). Jovanovic et al. (2016) point out that several product characteristics could influence how deep the transition to service provision should be. Hence, there needs to be some alignment among internal processes and the solutions strategy (Alghisi and Saccani, 2015), as well as between the strategy and the product characteristics (Jovanovic et al., 2016). The firm's product base also provides various motivations for servitization. For manufacturers of complex products these are mainly economic and demand-based motivations (Raddats et al., 2016). They are less focused on competitive-driven motivations such as to differentiate than manufacturers of non-complex products. Providers of non-complex products are subject also to demand-based motivations (Raddats et al., 2016). For providers of systems comprising complex products, the motivations are transformational and include new service business models and customer business transformation (Raddats et al., 2016). Such providers also have demand-based and economic motivations for engaging in servitization (Raddats et al., 2016). The degree of complexity is hence related to the motivation and the various dimensions of the integrated solutions (Nordin et al., 2013), which suggests different strategies in various companies.

Managerial challenges in the development of integrated solutions

Although opportunities and capabilities needed to move into being a solutions provider have been identified, it is also associated to risks and many companies fail to achieve the intended benefits (Benedettini et al., 2015; Brax, 2005). To create a seamless offering for the customer requires successful integration of products and service operations, being a major challenge for manufacturers (Johnstone et al., 2009). It means striking a balance between product and services innovation and that internal processes and capabilities are challenged in the transition (Martinez et al., 2010; Story et al., 2016). The difficulties related to the development of integrated solutions however requires more research. It has been argued and acknowledged that, with a few exceptions, the literature on integrating products and services is overly focused on how companies can succeed, and describing success stories rather than on the companies' experiences and the difficulties companies actually face (Johnstone et al., 2009; Windahl, 2007). The integration aspect puts very high demands on the organisation (Martinez et al., 2010), and a different focus are therefore especially important in the case of developing integrated solutions. However, most work focuses on front-end units despite argued that the resources and capabilities within the organisation could be perceived as competitive advantages. For development managers, integrated solutions development compared to product development is much more problematic and complex. Challenges are concerned with tasks or situations that put someone's abilities on test (Stevenson, 2010). 'Managerial' refer to managers (Collin, 2006, p. 245) and, hence, managerial challenges refer to the testing of management abilities in the resolution of problems. In this case, the problems are associated to the development of integrated solutions. A problem can be described as 'associated with the difference between some existing situation and some desired situation' (Pounds, 1969, p. 5). This indicates that the managerial challenges are associated to managers' perceptions of the desired and existing situations in development of integrated solutions and, hence, their experience thereof. To develop integrated solutions requires management of business, product and services innovation as well as integration, and it is argued that solutions development is about dealing with the complexity that arises (Windahl, 2015). This complex and challenging development needs to be better understood to facilitate provision of integrated solutions. The focus here is on managerial challenges related to the development of integrated solutions.

2.6. Developing the research questions

From the above, it can be seen that the distinction between products and services is not always clear, and that services is a rather fuzzy term. Servitization, being the addition of more services to offerings, poses several problems for manufacturers. The rationales and benefits of servitization are often highlighted and it has been argued that, in order to achieve the intended economic benefits and enable growth beyond the installed base, companies are recommended to adopt an integrated product-service business model (Visnjic Kastalli and Van Looy, 2013). Integrated solutions is a business model that implies the integration of products and services into a seamless offering that creates a value surplus for the customer (Brax and Jonsson, 2009; Wise and Baumgartner, 1999). However, the concept of integrated solutions is vague and there are various perspectives on an integrated solution. Despite the opportunities that integrated solutions provide, companies find it difficult to develop these new offerings and to integrate products and services. In companies offering integrated solutions, development is more complex compared to the development of products (Windahl, 2007, 2015), and development is challenging. This thesis investigates the managerial challenges related to the development of integrated solutions, to provide insights into how companies deal with an increasingly complex development.

The two research questions addressed refer to the vague concept of integrated solution, and the implications for the product development organisation.

Research question 1

Galbraith (2002) argues that there are two aspects to solutions development. The first relates to what solutions to provide and develop (Galbraith, 2002). While integrated solutions overall have been described as a business model combining products and services (Wise and Baumgartner, 1999), the previous research also identifies the existence of different solutions and offerings within the same company (Kowalkowski et al., 2015; Windahl, 2007; Windahl and Lakemond, 2010). As an emerging phenomenon, the concept of integrated solutions is still vague (Brax and Jonsson, 2009), and can refer to various kinds of product-service offerings. Since different solutions require different development approaches, it is important to identify and describe types of integrated solutions that exist. The first research question therefore refers to what should be developed and how the offerings can be described.

- How can integrated solutions be described?

The first step in the development process is to consider what to develop, which requires investigation of different integrated solutions, and how similar or different they are from each other, and in what ways. There may be many different solutions simultaneously within a company and companies often experiment with different offerings at the same time as providing pure products and services (Windahl, 2007). While the

concept of integrated solutions is vague, previous research agrees that an integrated solution is a combination of products and/or service, in which the aspect of integration is crucial (Brax and Jonsson, 2009; Davies, 2004; Windahl, 2007; Wise and Baumgartner, 1999). Those aspects, combined with the idea that integrated solutions address customers' specific operational needs (Davies, 2004; Storbacka, 2011), are the foundation for a description of integrated solutions.

Research question 2

Previous research discusses the challenges involved in moving into solutions provision, but less is known about the development of integrated solutions, and implications for the development organisation. While the development of solutions requires decisions about what should be developed, it also requires decisions about aspects related to the process required to develop the solution and, often, the development of a replicable solution (Galbraith, 2002). The development strategies are challenged (Shepherd and Ahmed, 2000) and the complexity of overall development increases (Windahl, 2015). Despite an increased complexity in the development, manufacturers also have advantages related to their products and the product development (Ulaga and Reinartz, 2011; Wise and Baumgartner, 1999), which are still important to consider. To manage the complexity and to utilise those resources, implications of the change need to be further investigated.

Previous research agrees that the design of simple products or services differs from the design of integrated offerings (Velamuri et al., 2011), but does not specify in what ways and how. Further, the higher the degree of integration, the greater the implications for the design of the solution (Martinez et al., 2010). Thus, a change from focusing on products to developing integrated solutions has major implications for the overall organisation, including the product development. Research has emphasised the need for integrating various stakeholders and components in the process of developing the integrated offering (Parida et al., 2014; Velamuri et al., 2011), which has implications for the product development organisation. The second research question addresses those implications.

- What are the implications for the product development organisation when a manufacturing company moves into provision of integrated solutions?

An implication can be understood as a likely consequence from something, even though not explicitly stated from something, even though it is not being explicitly stated (Stevenson, 2010). The consequence in this case is the changes in the product development organisation. The implications refer to the consequences for managers related to the development of integrated solutions.

3. Research methodology

This chapter describes the research design and research process and discusses the decisions in the research process, their underlying reasons and the implications for the research.

3.1. Research design

The research methodology should be related to the research purpose and research questions (Edmondson and McManus, 2007; Maxwell, 2012). In this thesis, the purpose and the research questions concern an evolving phenomenon rather than relationships between constructs. More open-ended research questions require the collection of qualitative data (Edmondson and McManus, 2007; Flick, 2014). Further, if the constructs and the phenomenon are not well defined and are still emerging, rich empirical data are needed to understand it (Edmondson and McManus, 2007). These considerations dictated the choice of a qualitative case study approach, suited to the complex context of the case (Eisenhardt and Graebner, 2007). The integrated solutions involved not just the solution that is developed; it involves the emerging context and requires an approach that facilitates study of the phenomenon embedded in a context. When a manufacturing company develops a solution focused on delivering value-in-use for the customer (Storbacka, 2011), for example, by providing the customer with availability of their operations, the overall development process is affected compared to development of a simple physical product. The development process is integrated within the context in which it was taking place, and the context provides the foundation for the process, including industry, customers and knowledge base. This requires a research design that is sensitive to the context such as a qualitative case study.

Managerial challenges in the development of integrated solutions are subjective and depend on who is involved in the development process and their perceptions. To capture subjective viewpoints regarding the challenges and tensions that might arise during the development of offerings integrating products and services to provide value surplus for customers, a qualitative case study is argued to be appropriate. To conduct research involving empirical qualitative and subjective data, requires flexibility to allow exploration of interesting paths and to obtain exciting insights. This flexibility is enabled by a case study approach (Dubois and Araujo, 2007).

Data were collected mainly through semi-structured interviews. These semi-structured interviews allowed discussion of the challenges associated to the development of integrated solutions and good coverage of the topic of interest while allowed for follow-up questions (Bryman and Bell, 2011). Since the research examines managerial challenges, the interviewees were all managers associated to the development in different ways, with knowledge about solutions provision and the development of integrated solutions.

Table 3 presents in brief the data collection methods related to the research questions, and their connection to the conducted studies in this research.

Table 3 - Research questions, research design and studies

Research question	Chosen research design	Study
RQ1: How can integrated solutions be described?	Literature review	Kappa
	Qualitative case study, including interviews with respondents with knowledge of the solution portfolio, and study of documentation describing integrated solutions provided	2
RQ2: What are the implications for the product development organisation when a manufacturing company moves into provision of integrated solutions?	Qualitative case study, including interviewing managers associated to the development of integrated solutions	1 3

3.2. Empirical context

The three companies studied in this thesis are all large manufacturing companies that have moved into offering more solutions for other companies. All three companies were manufacturers of physical products, although firms can move into the provision of integrated solutions from either a product or services base (Davies et al., 2006). The present research is on the area of servitization and the focus is on manufacturers with a base in physical products that have moved to provision of integrated solutions. For manufacturers, a move to provision of solutions rather than only products is challenging (Oliva and Kallenberg, 2003). Since the research aims to investigate these challenges, it studies established manufacturers. The selection of case companies was based on several criteria, including that they should have a base in physical products, that they should have moved to servitization, and that they should be providers of integrated solutions. In addition, the companies should be technology-intensive and be operating in a business-to-business context. The provision of solutions to other companies requires customisation and adaption of each solution to a particular customer, which can be both difficult and costly. Those criteria resulted in the selection of three companies positioned as solution providers, highlighting servitization in their company strategy. While many companies fitted the criteria, the companies chosen are all based in Sweden and were willing to give access to relevant interviewees and provide descriptions of the solutions and their development. Three companies were did this and were further investigated. The three companies operate in different industries and businesses, but all target business customers. Table 4 presents in short the case companies.

Table 4 - Case companies

	Alpha (Study 2)	**Beta (Study 1 and 2)**	**Gamma (Study 3)**
Company size (Employees, rounded)	50 000 employees (all divisions)	1 000 employees	100 000 employees (all divisions)
Industry	Security and door opening solutions	Telecommunication / Healthcare solutions	Transportation
Customers	Business-to-business, some business-to-customer	Business-to-business	Business-to-business
Respondents	CTOs of two different divisions, directors of innovation and R&D (4 respondents)	CEO, Managers product, service and solution development, product and portfolio managers. (10 respondents)	Directors service development, service owners, project managers service development (6 respondents)
Additional information	Tradition of and focus on acquisition of other companies (including a formal acquired growth goal).	Heavily focus on the strategy of becoming a solution provider. As a part of that strategy, mainly targeting the healthcare segment.	Recently went through a transformation and re-organisation.

3.3. Research process

This thesis consists of three papers, based on three studies conducted during 2015 and 2016. All three are case studies whose main sources of data were interviews, supplemented by internal and external documentation (e.g. presentations and reports), discussions and meetings. Figure 1 depicts the links between these studies and the research questions. While the main contribution to RQ1 is paper 2, and papers 1 and 3 correspond mainly to RQ2, all three studies, to some extent, address both research questions.

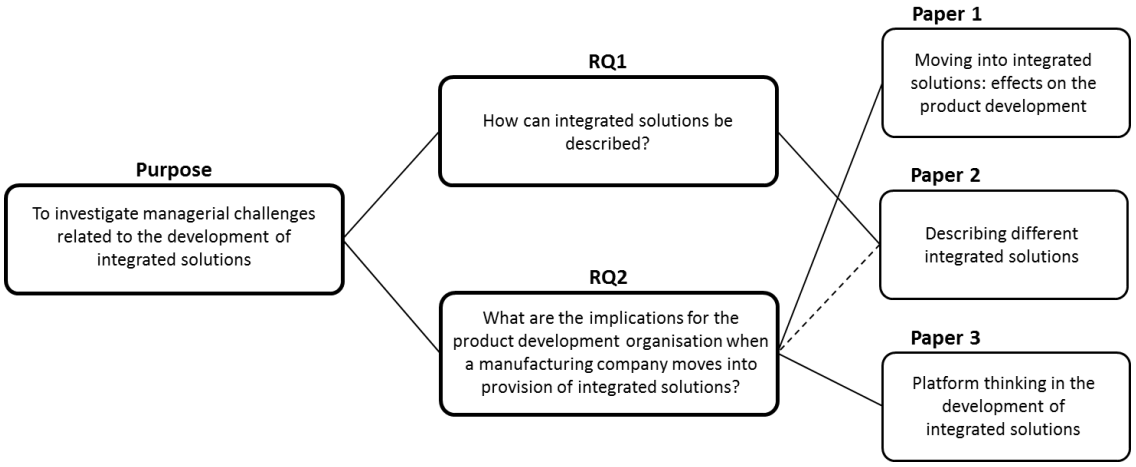

Figure 1 – Purpose, Research questions and Papers

The three papers are based on data from three case studies, which were carried out during 2015 and the first half of 2016. The studies involved three companies which are referred to as Alpha, Beta and Gamma. Table 5 summarises the research design used for the studies, including case selection and data collection.

Table 5 - Methodology in papers

Paper	***Paper 1:*** *Moving into integrated solutions: effects on the product development*	***Paper 2:*** *Describing different integrated solutions*	***Paper 3:*** *Platform thinking in the development of integrated solutions*
Study	Study 1	Study 2	Study 3
Purpose	To identify what in the product development that is affected in the early phases of a transition towards integrated solutions	To investigate how various dimensions can be used to describe different integrated solutions	To explore how platform thinking applies in development of integrated solutions
Companies	1 (Beta)	2 (Alpha and Beta)	1 (Gamma)
Case selection	The whole company (not only individual units) should be moving into provision of integrated solution (a general movement affecting the whole company, including the product development) Access of in-depth data	Variation between cases in terms of heterogeneity of solution portfolio Access to interviewees with knowledge of both portfolio and development	A case that was familiar with the platform concept, developing integrated solutions Long-term experience of product platforms, some experience of repeatable solutions/services
Data collection	10 semi-structured interviews conducted in 2015 Additional data: 3 presentations/discussions, Internal and external documentation, informal discussions	8[A] semi-structured interviews conducted in 2015, externally available documentation on different solutions provided by the companies Additional data: informal discussions, meetings, internal documentation	6[B] semi-structured interviews conducted in 2016 Additional data: documentation, informal discussions and meetings

[A] 4 of the interviews covered data used in both paper 1 and 2. All interviews were conducted by the author.

[B] All interviews were conducted by the author, in one interview was also the co-author of paper 3 present.

Figure 2 provides an overview of the research process, including studies and associated papers. The studies are described below in chronological order.

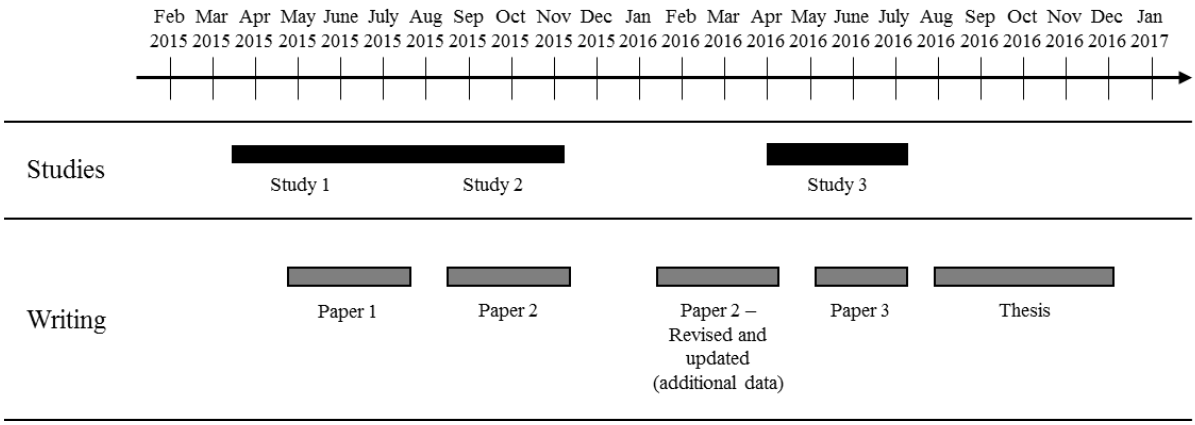

Figure 2 - Research process

Study 1

In February 2015, the first exploratory study was initiated in order to obtain insights into practitioners' perceptions of the concept and the development of integrated solutions.

The initial study was exploratory and involved quite open research questions. The interview guide was based previous literature regarding work on servitization and solutions provision, focusing on different aspects in the development of the solutions. The case company (Beta) offered possibilities for gaining insights into the company´s current work of moving into provision of integrated solutions, following a former focus on the provision of products or services separately. The company described several challenges involved in the move to integrated solutions and the development of replicable solutions to achieve economies of scale. The principle informant, as proposed by Voss et al. (2002), was identified as a senior manager associated to the company's R&D function. The contact person was familiar with both the organisation and the topic of interest. Interviews were considered favourable for data collection because they enabled discussion of various aspects connected to the subject and allowed for specific coverage of key topics (Bryman and Bell, 2011). The principle informant helped to identify other interviewees with knowledge of the subject, and gave access to the organisation. Semi-structured interviews were conducted face-to-face and lasted around one hour each. All interviews were recorded, using a dictaphone, and took place in either a conference/meeting room or the interviewee's office. The questions were mostly open-ended and allowed the interviewees to formulate their own answers. Follow-up questions were posed to enquire about interesting topics that emerged during the interviews or were used for clarification and further exploration of an answer. The semi-structured interviews allowed adjustments of questions and the focus of the different respondents, and captured respondents' perceptions. The interviews were supplemented by informal

discussions and documentation provided by the company. Three presentations/discussions were carried out, including presentation of the results from the study followed by a discussion. The presentations involved the product development and service development units, with associated personnel.

As qualitative data often result in large amounts of data (Bryman and Bell, 2011), the author applied a 'pre-coding' technique (Saldaña, 2015) in order to highlight data that seemed most interesting for the topic. This was achieved by highlighting specific words or phrases in the interview notes. Although interview notes often are 'sketchy' and limited compared to all of the content discussed in the interview or meeting (Miles et al., 2013), they were considered by the author to indicate the points that were considered important in the meeting between interviewer and interviewee. They guided further coding by providing some 'key words' for codes to be attached to quotations from the interviews. The first round of coding was aimed at assigning codes to data sets (Miles et al., 2013) by identifying codes that captured the essence of a sentence or paragraph in the interviews. This resulted in a 'library' of codes which were applied to successive interviews and identified similar or contrasting statements in the different interviews. Such an approach is usual when applying a coding procedure (Flick, 2014). The codes were grouped and displayed in a matrix.

Study 2

During study 1, a related study was set up: Study 2. This study aimed to investigate in more depth the complexity of the concept of integrated solutions identified in study 1 and in previous research arguing that several solutions can co-exist within the same company (Kowalkowski et al., 2015; Windahl and Lakemond, 2010; Windahl, 2007). The foundation for study 2 was the different characteristics or dimensions of the concept of integrated solutions identified in the literature, from which an analytical framework was developed. The interview guide for this study built on this framework, which facilitated analysis of the data. Study 2 involved four interviews with interviewees from study 1 (and some additional shorter follow-up interviews). Four interviews with employees from another company (Alpha) were also conducted. This company was chosen to achieve a variation among the cases regarding solutions portfolios, in order to capture and investigate the differences and similarities among the integrated solutions also within each company. The interviews conducted at Alpha were telephone or Skype interviews, and were recorded using a dictaphone. The interviewees were identified by the first respondent after a short discussion with the interviewer about the information being sought. The interviewees were managers with knowledge of both the overall development process and the solutions portfolio. The study also included analysis of external documentation on the various solutions offered by the two companies. The analysis was based on the framework identified and the dimensions and characteristics of the integrated solutions, from which the codes were derived. The procedure proposed by Miles and Huberman (1994) was used, starting with reducing the data, displaying the data and then drawing conclusions and verifying them. The codes (from

the framework) were used first, to reduce the data to allow a focus on the various aspects described in the previous literature and to eliminating offerings that were not integrated solutions. The sentences/paragraphs linked to the various characteristics, with examples of each element, were structured in a matrix and then compared. The data were displayed in a structured way (Miles et al., 2013) based on the framework, and accompanied by descriptions of the various aspects emerging from the cases. Second, the data were structured based on similarities and differences between the offerings from the same company. They were compared with raw data by a re-examination of the interviews and documents. In addition, representatives from the companies were asked to check the findings.

Study 3

Study 2 revealed various challenges associated to the co-existence of different integrated solutions within one company. Study 1 showed that product interfaces are affected in the move to integrated solutions because of the need to develop repeatable solutions. Following those studies and findings, Study 3 was initiated. The advantages of platform strategies have been emphasised for achieving a balance between customisation and the need for standardisation in development of physical products. However, with a few exceptions, little attention has been given to platform strategies for development of offers that combine products and services. Study 3 emerged from the discussion of platform strategies in Robertson and Ulrich (1998) in relation to integrated solutions and their characteristics. It aimed to investigate use of platform thinking in the development of integrated solutions at a company (Gamma), which used product platforms and, at the time, was working with development of repeatable solutions. Six interviews were conducted in spring 2016; the data were supplemented by information from informal meetings and discussions, and documentation. The interviews lasted between 60 and 120 minutes, and were recorded using a dictaphone. All the interviews were conducted in the company's meeting rooms. The interview guide for this study was constructed as a matrix, with the result that the starting point for the analysis was provided in the interviews. The matrix was provided to the interviewees before the interview. Most of the interview questions were open-ended to allow interviewees to formulate their own answers. Follow-up questions were posed to examine in more depth specific areas and interesting subjects, highlighted by the interviewees. The data were analysed using the lens of the four types of platforms proposed by Robertson and Ulrich (1998). Hence, the data to a large extent were structured based on codes from the framework. Extensive interview notes were taken in accordance with the matrix and were complemented with free text when necessary. The codes used to analyse the data originated mostly from the framework, but were complemented by some codes based on the empirical material, resulting in a combination of deductive and inductive coding (Miles et al., 2013). The codes derived from the data allowed interesting aspects to be followed up in the interviews.

3.4. Research quality

It can be argued that depending on the research perspective and paradigm , different approaches to evaluate the quality of the research can be applied including the concept of trustworthiness (Bryman and Bell, 2011), which is based on four criteria; credibility, transferability, dependability and confirmability. To some extent, these aspects can be linked to ethical considerations, for example, regarding other's access to the raw data. However, the thesis author believed that respondents would feel more comfortable and would provide more insights, if their data were anonymised. In addition, the possibility for companies to reading the material prior to publication (conference or journal) is important for both quality and ethical reasons.

Credibility

Building on the assumption that reality is subjective, the issue of credibility in qualitative research is related to the extent to which results for and views on the reality reported by the researcher correspond to the interviewees' reality (Bryman and Bell, 2011) and their constructions in their specific context (Halldorsson and Aastrup, 2003). Respondent validation is useful (Miles et al., 2013), since validation of results could reduce misinterpretations (Bryman and Bell, 2011). Respondent validation was achieved in several ways. In the first study, three presentations and discussions were carried out, giving respondents and other participants opportunities to provide feedback on the conclusions and results, and allowing further discussion of the topic. In addition, representatives of the company were asked to read the final paper.

In the second study, the results and the paper were sent out to the respondents. In the third study, the results were examined by representatives of the case company. Also, during various meetings and discussions, the results and conclusions were discussed to ensure their accuracy in the view of the participating companies. Respondent validation was conducted after the conclusions were formulated, along with additional data (e.g. from documents). Credibility was also considered during the interviews by ensuring that questions were understood correctly. This is one of the advantages of collecting data via semi-structured interviews, allowing for follow-up questions, and rephrasing if the questions are perceived as unclear.

Transferability

The concept being studied, integrated solutions, is closely aligned and connected to the context in which they exist. This has a major impact on transferability, relating to the possibility to make claims about whether the findings are applicable to other settings (Halldorsson and Aastrup, 2003). Both time and space are important aspects related to the context and can reduce generalisation (Halldorsson and Aastrup, 2003) which applies especially in relation to servitization and development of integrated solutions. The contexts of the cases involve not simply the companies and their industry, but also the level of development of their transition. Thus, time is important due to the transformations taking place in the companies. Although the

servitization transition in itself is not the focus of this research, it is necessary to consider that integrated solutions are perceived as an advanced form of product-service offerings (Shelton, 2009). Overall, it is argued essential to provide a 'thick description' of the context and the case, in order to allow readers to evaluate the potential applicability of the findings to other settings (Bryman and Bell, 2011; Miles et al., 2013). Due to the qualitative nature of this research, there are several limitations on generalisability in the traditional sense, although it can be argued that there are possibilities for analytical generalisation. Relating the research to the previous literature on the subject, increases its transferability. By relating the findings from a specific context, to previous research carried out in other contexts, allows the potential for transferability to be discussed. Research on integrated solutions have been linked to high-value, highly-customised and engineering intensive sectors (Brady et al., 2005; Hobday, 1998), while the impact of product complexity also have been discussed (Nordin et al., 2013). Further, most work on servitization focuses on large companies and, although this could be considered a weakness, it is also a strength in the context of transferability since it allows for comparison between the research settings of this thesis and previous research in the field.

Dependability

Dependability is linked to the issue of reliability and whether the findings apply at other times (Bryman and Bell, 2011). This can be achieved by careful documenting and recording of all the steps in the research process, including the decisions made and the reasons for these decisions (Bryman and Bell, 2011; Halldorsson and Aastrup, 2003). To ensure dependability in this research, all the interviews were recorded (with informed consent) and notes were taken during interviews, meetings and discussions. To achieve dependability, data should be stable over time and between researchers (Miles et al., 2013). Although it is unlikely that the same respondent would give identical answers in another interview, two masters students conducted interviews with some of the same respondents from study 1; the results showed consistency of data (answers) in each interview.

Confirmability

Confirmability criteria is similar to objectivity and concerns the extent to which the researcher's values have affected the study and the findings (Bryman and Bell, 2011). This hence refer to researcher bias (Halldorsson and Aastrup, 2003). Although complete objectivity in research is neither possible nor desirable, confirmability relates to the researcher acting in good faith in the conduct of the study (Bryman and Bell, 2011). In the present research, the researcher tried to be as 'neutral' as possible during the interviews, meetings and discussions and not to 'steer' respondents. Staying as close to the data and previous literature as possible in the discussions increased confirmability. However, the author's 'underlying values' are bound to have some effect on the topic and conduct of the study.

4. Summary of appended papers

This licentiate thesis includes three appended papers. This section provides a short summary of each paper, focusing on key contributions to the two research questions. The papers are presented in chronological order.

4.1. Paper 1

Jagstedt, S., Persson, M. and Lindlöf, L. (2015), "*Moving into integrated solutions: effects on the product development*", The paper was presented at the 16th International CINet Conference, September 2015, Stockholm, Sweden.

The overall organisation is affected by the move to integrated solutions, which imposes new demands on internal processes. Manufacturers' traditional ways of working are challenged and different resources and knowledge are associated with the new development. Despite product development being a central function in a manufacturing company, it is not clear in what way this function is affected by a transition to integrated solutions. This paper therefore aimed to identify what in the product development that is affected in the early phases of a transition towards integrated solutions. The case study included ten interviews and additional data collected from presentations, documentation and discussions. In the paper, it is firstly concluded that one aspect influenced by the move to integrated solutions provision is product interfaces, which must be re-designed to allow repeatable, but adaptable solutions. This could include creation of open interfaces to include external products and services in the solutions. Second, since integrated solutions address the customer in a different way compared to pure products or pure services, the value proposition changes, which has implications for development. In the case company, the value identification process included identification not only of the customer's needs in the short-term but also identifying potential improvements for their future operations. Since the lead time for the development of products is longer than for services, research on long-term needs and user behaviours is increasingly important to enable integration of products and services into an integrated solution. Third, there seems to be a simultaneous drive for both local and central development. The knowledge existing in the local offices, close to customers and the sales offices, is needed to adapt solutions to customers, as is knowledge about how to optimise operations and technology knowledge existing in the central R&D function. Meanwhile, capabilities need to be developed in the front-end and the back-end units, and coordination needs to be managed. The interactions between central and local development and configuration are argued to increase, and knowledge must be shared in order to develop integrated solutions suited to the customer while also staying profitable.

4.2. Paper 2

Jagstedt, S. and Persson, M. (2016), "*Describing different integrated solutions*", under review in an international journal. An earlier version of the paper was presented at the 4th International Conference on Business Servitization, November 2015, Madrid, Spain.

The integrated solution concept is vague and there is little consensus on a specific definition. Also, solution classifications often are based on comparisons between companies and their business models. While different solutions require different approaches in the development, the co-existence of various integrated solutions within each company is partially neglected in previous research. Integrated solutions need to be described also within each company in order to decide what to develop.

In relation to the co-existence of different solutions within one company, this paper investigates how various dimensions can be used to describe different integrated solutions. The paper analyses integrated solutions provided by two case companies, based on three dimensions of integrated solutions; addressing the customer, integration and customisation. The paper concludes that the concept of integrated solutions can refer to various solutions within a company, which correspond to all three dimensions in different ways.

Regarding the first dimension – addressing the customer – it was concluded that various solutions address the customer in different ways. Often, overall problems or challenges that have a major impact on the customer's operations, are targeted. Companies aim to create a value surplus, for example, by facilitating or optimising a flow or process. From the cases it can be concluded that understanding the customer is necessary for the creation of an integrated solution; however, the biggest challenge is how to transform this understanding into something that provides value for the customer. Understanding what the customer wants is not enough. Respondents from both companies highlighted the need to understand the user, and the usage of the solution, since this knowledge can facilitate the creation of a value surplus. Companies need to consider opportunities and input coming from customers, products, services and knowledge associated to the development. It has been argued that integration is the starting-point for value creation resulting from use of an integrated solution. Integration is a way to address individual customers' needs and is even considered a service component of the solution. However, there are various degrees of integration, among both components and the solution and the customer's systems. It seems that several of the case companies' integrated solutions are developed as unique solutions, and the challenge is to develop replicable solutions to transform the company into a solutions provider. Platform and modular strategies are proposed as potentially fruitful ways to manage the need to balance customisation and standardisation.

4.3. Paper 3

Jagstedt, S. and Persson, M. (2016), "*Platform thinking in the development of integrated solutions*", The paper was presented at the 17th International CINet Conference, September 2016, Turin, Italy.

This paper acknowledges the issue of balancing customisation and standardisation in the provision of integrated solutions, with a focus on platform strategies. While platform strategies are common in the provision of physical products, less is known about their use to develop offerings integrating products and services. This paper explores whether and how platform thinking applies to the development of integrated solutions. The paper builds on the four platform categories proposed by Robertson and Ulrich (1998) - components, processes, knowledge, and people and relationships, combined with aspects of integrated solutions.

It is suggested that platform thinking can be valuable to facilitate the development of repeatable solutions. The paper considers that platform thinking in the development of physical products might differ from the development of integrated solutions, and should include a broader view of what is meant by 'platform' and what assets should be shared by the solutions. This has implications for managers involved in the development and delivery of integrated solutions.

Overall, it seems as there is an increased importance of considering knowledge, and people and relationship platforms, often combined as knowledge platforms in development of integrated solutions seem closely related to people and relationships platforms. Since much knowledge is embedded in people these two categories of platforms would seem to be aligned; people and relationship platforms are involved in the organisation of a knowledge platform. For example, to utilise knowledge about the user and usage, a combined people and relationship platform and a knowledge platform might be appropriate. This would include integrating people from various functions in the organisation. In addition, technology platforms and the inclusion of external partners' technology, seem a potential way to move forward. This would include involving people with expert knowledge, and integrating externally and internally available technological knowledge in the development of the integrated solution. In addition, component and software platforms appear to be prerequisites for the development of repeatable solutions, while process platforms could facilitate integration during the development of an integrated solution. This would include integration of components and functions, and customer and supplier. Although there are formal processes for separate service and product development, there is no formal integration of these processes. To facilitate such integration, an integration process platform might be applicable.

5. Discussion

This chapter discusses the research questions. First, research question 1 on describing integrated solutions and then research question 2 on the implications for the product development organisation.

5.1. Describing integrated solutions

Paper 2 suggest that different integrated solutions correspond to three dimensions, namely addressing the customer, integration and customisation. These three dimensions are used to address and structure the discussion of the first research question.

In chapter 2 of this thesis, the concept of integrated solutions was discussed. Based on that discussion, the three dimensions identified in Paper 2 and additional input regarding the concept and the perception of integrated solutions from the other papers, a definition of an integrated solution is proposed: an integrated set of products and services which, through the use of technology knowledge, facilitates the creation of a value surplus in relation to the customer's operational needs.

This definition refers to an integrated solution as an offering and not a business model as in Wise and Baumgartner (1999). It has been argued in previous research that several solutions can co-exist within the same company, and that companies experiment with various offerings simultaneously (Kowalkowski et al., 2015; Windahl and Lakemond, 2010). Companies often provide a variety of offerings, including products, services and different integrated solutions as seen in the appended papers. In Paper 2, it was concluded that the various integrated solutions can differ from one other within the same company. Hence, comparisons of integrated solutions cannot simply be made across companies; rather the offerings from the same company should also be studied in order to adapt the development to what is developed and needed.

An integrated solution in this thesis includes products, services and knowledge. While products and services are key components of the offering and are highlighted in previous definitions, knowledge can also be considered a component. This is in line with Valtakoski (2016) and an increased focus on knowledge as a component in solutions to facilitate value creation. Some superior knowledge to the customer's knowledge is crucial to facilitate a value surplus for the customer. This is often knowledge on technology and products, for example, related to the best use of the solution in different environments. This can help customers to improve their operations, for example, by solving a problem that the customer is unable to resolve internally. This knowledge includes technology knowledge and, also, knowledge about the user and its potential usage of the solution.

The proposed definition relates to the first dimension - addressing the customer – by stating that it should create a value surplus, namely a value beyond what the individual components would create if they were

delivered individually (Brax and Jonsson, 2009; Nordin and Kowalkowski, 2010), associated to the customer's operational needs. It relates also to the aspect of integration by stating that the solution is an integrated set of products and services. Integration enables a value surplus. Lastly, in relation to the dimension of customisation, the definition *does not* state that the solution must be unique, tailored or customised. Important here is that the solution should address the customer's needs, not that it should be unique from the supplier's point of view. In that sense, the argumentation in this thesis is in line with Brax and Jonsson (2009). Nevertheless, it is desirable to develop integrated solutions that are perceived as customised to the customers, but are built on shared assets. This is proposed in Paper 3 and is discussed further in this chapter.

Addressing the customer

The first dimension related to describing integrated solutions, identified in Paper 2, refers to how to address the customer. Paper 2 describes various ways including problem solving, facilitating or managing customers' processes, and optimising customer flows. All of these are related to a broader view of the customer's business and needs, beyond a focus on products. Previous research has highlighted the importance of an increased focus on the customer, for example, a more customer-focused organisation has been proposed (Galbraith, 2002). According to the findings in these papers, an increased focus on the customer is necessary, but - as the companies highlighted - is not enough. To facilitate a solution surplus as described by for example Miller et al. (2002), the valuable knowledge and capabilities of the solution provider is required. That could facilitate an outcome for the customer not available otherwise, as understanding the customer must be followed by actually addressing that understanding. Paper 1 showed that the process of identifying value for the customer changes with different value propositions and solutions, and has implications for product development (discussed in section 5.2). Paper 2 highlights that companies need to be able to translate a broad understanding of customer operations and businesses, into something that could facilitate value surplus for the customer, which requires supplementing the customer's knowledge in order to improve or facilitate its processes. This requires the solution provider to be more knowledgeable than the customer about certain aspects. It suggests that Brax and Jonsson's (2009) statement about balancing technology and customer focus is legitimate, since knowledge in both areas is needed in order to develop integrated solutions that address the customer's operational needs and problems.

All three papers indicate the need for an increased focus on the user in order to provide the customer with an integrated solution addressing the operational needs. For example, Company Beta conducts user studies, including shadowing of nurses, in order to understand its customers' operations, processes and problems. A respondent in company Alpha is arguing that what is valuable for the user of the solution most often is beneficial for the overall customer company and its business. Paper 3 argues that knowledge about solutions

usage based on use data can create benefit for both the solution providing company and its customers. This is implied by all respondents, and it is proposed specifically by two respondents in company Gamma (Paper 3) that a new segmentation should be considered to allow a focus on the user of the integrated solution rather than the customer companies and the industries they are working in.

Customers frequently have problems related to their operations which they need to resolve. To solve those problems is one way of addressing the customer. Storbacka's (2011, p. 699) definition of integrated solutions include 'strategically important customer specific problems'. Paper 2 shows that what is considered a strategic problem can differ among different customers and, although an integrated solution has an impact on operations, whether it resolves the company's particular strategic problem is questionable. An integrated solution can provide also a value surplus for the customer and, in addition to solving a problem, an integrated solution can aim at optimise, facilitate or maintain the customers' operations. In Paper 2, both company Alpha and Beta were concerned for example about facilitation or optimisation of the flow of their customers' operations. Operational flow can for example in these cases refer to hospitals and the flow of patients, nurses and other hospital personnel.

Integration

An integrated solution is not just a combination of solution components; the integration is a fundamental aspect. Integration has been argued to make a major difference compared to other kinds of offerings (Johansson et al., 2003), and to allow a value surplus (Brax and Jonsson, 2009; Nordin and Kowalkowski, 2010). Paper 2 showed that companies Alpha and Beta used words such as 'seamless' and 'integration' to describe their solutions in official documents, for example, referring to 'integrated workflow solutions'. All the respondents said that integration was crucial to the solution value. Respondents from Alpha suggested also that the extent and degree of integration differs among solutions and market segments and depends on the objective of the integration. Is it to spread the cost over time for the customer by avoiding an initial investment, or is to integrate the solution with other systems[3] in the customer's operations? Hence, there appear to be a difference in the degree of integration among different solutions, which can be explained partly by the division between commercial and technical integration. This refers to various ways of integrating products and services. Johansson et al. (2003) and Park et al. (2012) highlight differences between technical and commercial integration. Johansson et al. (2003) categorise companies according to how they carry out the integration, while Park et al. (2012) distinguish among different concepts. Paper 2 shows that there are also differences among different various integrated solutions within the same company,

[3] System can be defined as "an arrangement or organisation of things which work together" (Collin, 2006, p. 406). Further, components are affected by being in the system (Law, 2016), and the behaviour of the system is affected by the components within it. In this case, the systems in question are usually software or IT-based systems used by the customers in their operations, and the integrated solution should work together or be integrated with those systems.

related to the degree of integration and how it is achieved. These different kinds of integration seem to require different sets of knowledge and usually are the responsibility of different functions in the company. While commercial integration usually is the responsibility of the sales function or the marketing department, technical integration is handled by the service or product development organisation. This is discussed also in Park et al. (2012).

To retain ownership of the products as a solution provider, described as fully-fledged integrated solutions by Windahl (2007), can be perceived as commercial integration of components. This kind of integration occurs in some solutions, but it is in this thesis argued that it is not a prerequisite for an integrated solution; it is rather an example of a commercially integrated offering. This is linked also to the discussion on provider-owned equipment in Park et al. (2012), where integration does not necessarily include technology. In Paper 2, the respondents from both companies argued that the question of ownership is partly a customer decision, but also affects whether the supplier might want to move into 'being a bank', as one respondent in company Alpha put it. Alpha respondents also highlighted that customers might or might not want to buy the equipment for accounting reasons. This was discussed also by Beta respondents, who said that the question of ownership became even more complex if software is included in the solution, due to licenses. In that sense, as Windahl (2007) points out, ownership is not straight forward and ownership of some components might be retained by the supplier and others transferred to the customer.

While commercial and technical integration can differ, Johansson et al. (2003) argue that companies can combine technical and commercial integration. Paper 2 described integrated solutions that optimise flows which usually involve this combination. In those cases, the solution is provided as a seamless combination of products and services, sometimes with the product being offered as a service in which the ownership is kept by the supplier. Further, the solution is aiming at optimise a workflow, and therefore it is also integrated technically via software between components in the offering, and towards other systems in use by the customer. In such cases, it would seem that integrated solutions involve integration efforts from employees and organisations with technology and engineering knowledge. This type of solution can be described as engineering-oriented integration (Park et al., 2012) and emphasises the importance of technological knowledge in development of integrated solutions for integration purposes.

Brax and Jonsson (2009), highlight integration among solution components to create a seamless offering, and also integration between customers' and supplier's systems. This is also seen in Paper 2, in which the respondents argue that the solution needs to be integrated with the customer's systems and contexts in order to create value. This is in line with the idea of value-in-use (Grönroos, 2011; Storbacka, 2011). Respondents in companies Alpha and Beta argued that integration towards the customer's systems is a unique process since customer layouts, processes and systems all differ. While integration among components can be

achieved commercially and/or technically, integration towards customers' systems seem to require some technical integration. Following the logic of a service as a process, performance or act rather than an output (Rathmell, 1966), Paper 2 shows that the process of integration into the customer's existing systems can also be perceived as a service. Also, the various customer contexts and operations require technical competence of the solution provider and an understanding of the customer's operations and usage to achieve successful integration. Application of the solution may or may not be dependent on other processes, sometimes related to strategic problems, as suggested in the integrated solution definition proposed by Storbacka (2011). While some integrated solutions might be related to outsourcing of operations for the customer, others might be related to problem solving and shared responsibility between customer and supplier. For example, Paper 2 describes some solutions which are integrated in the customer's existing systems, including joint management of the process by a third party. This is related to the idea of system seller and system integrator as described by Davies et al. (2007). All three papers make it clear that an integrated solution is a complex offering, requiring knowledge of integration, and involving both internally and externally developed products and systems, all of which makes their development particularly complex and demanding.

While the integration of components in a solution, and between the solution and the customer's current systems have been highlighted, Paper 3 suggests that the product and service development processes also need to be integrated. Other research also point so the need for closer collaboration between internal functions and actors (Parida et al., 2014; Windahl et al., 2004). In order to develop an integrated offering, its components need to be integrated in the development process (Parida et al., 2014). In technically integrated solutions, the integration is conducted during development phase (Park et al., 2012). Paper 3 shows that the integration process could be a potential platform in integrated solutions development. However, integration during development can be difficult and has to take account of the various lead times related to the development of the hardware, software and services as well as the organisational division of labour related to the functions responsible for the development of the different components.

Customisation

A high level of customisation is argued to be an important characteristic of an integrated solution (Johansson et al., 2003; Nordin and Kowalkowski, 2010). Various degrees of customisation have been discussed (Galbraith, 2002) and it has been shown that customisation can take place in various parts of the value chain where components may be more or less standardised (Nordin and Kowalkowski, 2010). It is argued in both paper 1 and 2 that a common basis might be important to develop integrated solutions in larger scale, while allowing for adaption to various customer needs is crucial. Paper 3 focuses on the balance between customisation and standardisation in particular by investigating platform thinking in relation to integrated

solutions. It seems that, despite arguments about the importance of developing repeatable solutions (Davies and Brady, 2000), integrated solutions are still often unique to an individual customer, as Paper 2 shows. However, it was clear that the case companies were aiming for the development of a common basis. In company Beta, achieving this is included in the definition of what they should develop and is described as a 'global solution'. The respondents from Beta (Paper 2) stated developing such solutions was the only way to move forward in the transition to becoming a solution provider. The rationale is related to the economic and practical constraints discussed in previous research (Brax and Jonsson, 2009; Ceci and Masini, 2011; Miller et al., 2002). In addition, respondents from Alpha (Paper 2) were of the opinion that the development of a common base was important for forward planning related to resources and capabilities. Starting from scratch each time is too time consuming. Papers 2 and 3 show, too, that a standard solution provides a means of communication with customers and enables a fast response to customers' demands. These reasons for developing a common base are in addition to the economic and practical constraints that were proposed.

Paper 3 argues that a common basis enables exploitation of the data from existing solutions, to develop new or improved solutions. This knowledge could become a shared asset among various solutions. Paper 3 further suggested the use of platforms to facilitate the development of a good practice benchmark, against which customers' operations could be improved. This knowledge is built up based on information from different customers and their solutions. Papers 1 and 2 discuss also modular products and services to balance the need for customisation and standardisation. Paper 1 suggests a rethinking of the product interfaces because the provision of an integrated solution provides more demands and possibilities to combine products, developed both externally and internally. Paper 3 concludes that 'platform thinking' in the context of the development of integrated solutions, would help to balance the needs for customisation and standardisation. However, it requires another perspective of what a platform could mean compared to development of physical products.

A level of customisation is needed in the development of integrated solutions since the solution must be able to be adapted to the operational context in which it is to be applied. This means that the integrated solution, to an extent, will be adapted to the customer's context. However, Brax and Jonsson (2009) suggest that the creation of an integrated solution suitable for the customer does not mean customisation per se. What is important is that the customer perceives the solution as valuable for its operations and as addressing its requirements and meeting its expectations. An integrated solution is not necessarily a unique solution, but rather a solution appropriate for the customer's operations.

5.2. Implications for the product development organisation

The second research question is concerned with the implications for the product development organisation of a manufacturing company when moving into provision of integrated solutions. Paper 1 addresses this by examining how product development is affected by a move into integrated solutions provision. The paper concludes that the product interfaces are affected and that there are implications in terms of global and local development of the solutions and the process of developing the value proposition. The findings related to the product interfaces suggest a strategy of modularisation (standardisation of the interfaces) to manage the need for both customisation and standardisation. Paper 3 analyses development through the lens of platforms (standardisation of assets) to explore how platform thinking could be applied in the development of integrated solutions.

The second research question is addressed through accounting for the need for multiple perspectives in the development of integrated solutions, the simultaneous provision of different integrated solutions, and centralisation and decentralisation of the integrated solution development.

The need for multiple perspectives

While research on solutions and servitization often takes a customer-centricity including being more customer and service oriented (Baines et al., 2009; Galbraith, 2002; Miller et al., 2002) there is also a need for user and technology perspectives in the development of integrated solutions. This need to balance different perspectives are also discussed in Windahl and Lakemond (2010). Windahl (2015) points out the lack of research on the challenges associated to managing both the technology and business innovation in the development of integrated solutions and suggests that solutions can also be described as technology-driven business innovations. Brax and Jonsson (2009) argue for the need to retain technology and product competences while also being able to take a customer perspective. This view is supported by Neu and Brown (2005), who argue that technology is still important for creating competitive advantage. The findings from this thesis are aligned to these arguments; they highlight the importance of not just focusing on one or another perspective in different parts of the organisation, but also the need to balance multiple perspectives within the product development organisation.

Starting from the customer, servitization requires manufacturers moving into solutions provision to be more customer-oriented (Galbraith, 2002; Miller et al., 2002). This view was endorsed by the respondents in this research, who argued solutions provision requires a stronger focus on the customer's overall problems and businesses compared to the provision of products. However, a respondent from company Alpha argued that competitors can listen to customer and propose methods and techniques for finding out about their problems, but what matters is the translation of this information into a solution actually addressing those needs and

problems. Hence, companies needs to go beyond listen to the customer, and for that aim, they have resources connected to their technical and product knowledge.

Companies Alpha and Beta both pointed to problems involved in defining who is 'the customer', when developing integrated solutions rather than products. This is because integrated solutions are designed to address overall needs and, thus, the solution user might be different from the function ordering the solution.

Papers 2 and 3 show that the user is especially important to the development organisation when providing integrated solutions. Companies Alpha and Beta both argue that understanding and knowledge of the user are essential for the development of an integrated solution. Respondents in company Gamma (paper 3) also argued that the user's experience was crucial for solutions provision. Four respondents from company Gamma discussed the segmentation in provision of integrated solutions compared to products, and two of those proposed a re-segmentation to classify solutions that dependent on the user rather than the market or industry they are operating in. That is, classifying a solution based on whether it is used by the driver or the planner of the overall operations for example, no matter what industry the customer is in.

One of the findings, about the process of developing the value proposition, from the study in Paper 1 was related to knowledge about customers' operations. It is necessary not only to understand the customer's need for a product, but also its day to day operations, which implies understanding the use and users of the integrated solution and their behaviours and problems. Storbacka (2011) points out that an integrated solution should provide value-in-use and, to achieve this, it seems as the users and the usage need to be thoroughly understood. So, in addition to a customer-orientation, the findings highlight the increased importance of the user and to apply a usage perspective during development of integrated solutions

To acknowledge and utilise resources that manufacturers compared to service providers could benefit from (including the products and associated knowledge, and their development (Oliva and Kallenberg, 2003; Ulaga and Reinartz, 2011; Wise and Baumgartner, 1999)), companies need to exploit their technology. This would allow manufacturers to create valuable, hard to imitate solutions for the market. In line with the arguments proposed in Paper 2, it is the development of a solution that address the customer operational needs that represent a competitive edge of manufacturers, having resources that service providers lack. Competitors might understand the customers, but might not have the same resources in terms of technological understanding, products and associated knowledge. The technology base also provides benefits and allows the knowledge associated to the product and the service provided to be utilised (papers 2 and 3). A platform perspective, as proposed in Paper 3, might allow economies of scale and utilisation of usage and user information to develop a benchmark for further customer improvements. All of this knowledge would help in the development of other integrated solutions. Hence, manufacturers have an

incentive to balance and apply service and product perspectives simultaneously, which increases the complexity of development as Windahl (2007, 2015) discusses. In addition, although technology and product knowledge have been shown to be essential to develop and enable integrated solutions, Paper 1 adds to these software competences and technical configuration capabilities. Companies need to both maintain and further develop their product and technical knowledge in order to facilitate valuable integrated solutions.

Paper 1 shows that the development is concerned with customers' current and future needs, and market and business trends. Development must be able to provide integrated solutions for the future. This is acknowledged in product development, but is argued to be especially challenging in the development of integrated solutions due to the increased focus on services and customers, often concerned with short-term needs. Since the development lead time is longer for a physical product than for a service, the development organisation must conduct thorough research on future market trends and future technology and avoid being trapped by customers' current needs. Researching future trends requires both a customer and a market perspective but also a technology perspective in order to understand what might be possible, and what might be enabled by new technology. Paper 1 highlights the need for research on future customer needs in order to stay abreast of the customers' operations and business, while also fulfilling short-term requirements. The development organisation must be sensitive to and knowledgeable about customers' current and future development needs, and from different time perspectives. This involves consideration of the customer and current usage, balanced by a focus on technology and market trends.

All these perspectives need to be managed by the development organisation, which must be able to adopt different perspectives and time horizons in order to develop solutions for the future and satisfy current needs. While previous research focuses mainly on the front-end units in the organisation, for example, the implications of a service-dominant logic for the sales force (Le Meunier-FitzHugh et al., 2011), the development organisation needs knowledge about the technology and solution use context. This provides competitive advantages for manufacturing firms compared to pure service providers (Oliva and Kallenberg, 2003; Ulaga and Reinartz, 2011; Wise and Baumgartner, 1999). It is important the development organisation does not overlook the technology and product perspectives but manages them simultaneously in the development. A move into integrated solutions provision does not just imply an increased focus on the customer, it includes paying attention to the technology and product knowledge. A user and usage perspective is argued in this thesis to be increasingly important to understand and address customers' operations. This knowledge could be the base for the development of different integrated solutions as argued in Paper 3.

Simultaneous provision of several integrated solutions

All three papers the existence of various integrated solutions, and describe various implications for the product development organisation. Moving into integrated solutions involves a new business model and management of the company's various offerings. The management of those co-existing solutions affects the product development organisation in different ways.

Paper 2 shows that Beta is considering the need for replicability in its definition of a solution and argues that not all solutions can be developed as unique offerings. Paper 1 highlights that requirements related to the product interfaces change in the move to integrated solutions since they combine different both internally and externally developed products, systems and services. Paper 2 describes the different integrated solutions in each company and shows that the companies often work with portfolios of different kinds of offerings. The study concludes that various integrated solutions address customers in different ways, and have different levels of integration and customisation. While integrated solutions were in focus of the paper, it should be noted that both companies are still providing different kinds of offerings. Paper 3 examined the development of integrated solutions and investigates how platform thinking can be applied to the development of integrated solutions to manage the development of several integrated solutions simultaneously.

Co-existence of multiple solutions and roles of solution providers is discussed in Kowalkowski et al. (2015), Windahl and Lakemond (2010) and Windahl (2007). They point out that there can be several solutions in each firm and, also, that solutions companies often provide pure products and pure services. Paper 2 argues that integrated solutions can refer to several different solutions co-existing in a company. This has implications for the product development organisation which has to deal with the need for both standardisation and customisation in development. Previous research argues that while integrated solutions need to be adapted to customers, too much customisation cannot be justified (Brax and Jonsson, 2009; Ceci and Masini, 2011; Miller et al., 2002), and there is a need for the development of repeatable (Davies and Brady, 2000) or replicable solutions (Galbraith, 2002). To balance customisation and standardisation is difficult when a company provide several different integrated solutions simultaneously.

Paper 1 emphasises the need to develop product interfaces that enable various products, services and systems to work together in different integrated solutions. Some of the respondents from Beta suggested the development of open interfaces to integrate external parties' products and systems. The need to re-consider the product interfaces is based on the provision of more than one integrated solution using different components, which has implications for the product development organisation. While managing and designing product interfaces in development of physical products has been well researched, less attention has been paid to managing component interfaces in development of integrated solutions, that is, solution modularisation. In relation to the standardisation/customisation debate, Paper 3 concludes that development

of integrated solutions requires another perspective on platforms than is usual in the development of physical products, as this is mostly focused on component platforms. In Paper 3, platform strategies are proposed as a way to manage the development of several integrated solutions within a company. While the focus is on platform thinking in the development of integrated solutions, platforms have been proposed by Eloranta and Turunen (2016) to deal with network complexity in service-driven manufacturing. Platforms could hence be useful for both the development of integrated solutions internally within a firm, and for managing relations within a supply chain.

There are major implications for the product development organisation from the simultaneous development of several integrated solutions. Development organisation managers are required to manage the solutions portfolio and ensure effective development of several integrated solutions simultaneously. This include to manage the balance of customisation and standardisation.

Centralisation and decentralisation

Paper 1 identifies the need for both central and local development which has major implications for the product development organisation. While most new product development takes place centrally, some product development and solutions configuration is accomplished in local offices that are closer to the markets. In addition, most sales and service activities are located close to customers. It is proposed that the organisation should have a back-end unit to develop long-term capabilities to ensure excellent products, and a front-end unit which is customer facing (Galbraith, 2002; Miller et al., 2002). However, the boundaries between these units are somewhat blurred and in order to provide integrated solutions tailored to the customers, the local organisations require also technology and configuration knowledge in addition to extensive knowledge of the customers' needs. Managing the integration of solution components is difficult and requires high levels of coordination and sometimes technical knowledge. In addition, the global development also need to access the users in order to develop valuable products for the future that are aligned to customers' needs.

It has been argued that companies need to the balance customisation in the front-end units and standardisation and capability development in the back-end units (Davies et al., 2006; Miller et al., 2002). This seems to apply to organisations in general and to development organisations in particular. While the central development organisation strives to develop a replicable, global solution, the local units are focused on developing solutions for their specific market. There needs to be several local units to cope with customers' specific needs and requirements. While companies need to be more customer-focused in the provision of solutions (Galbraith, 2002; Miller et al., 2002), conflict can arise between local units and central development related to the localisation of development. While they strive for different things, several of the aspects are overlapping and needed both centrally and locally.

The global organisation is concerned with the technology, user behaviour and usage of the overall solution. Paper 3 conclude that a user knowledge platform could be used for the development of integrated solutions. Platforms usually are developed by central R&D departments which requires customer knowledge to be located centrally in addition to local, more specific knowledge. Further, the local units which have direct access to customers, need knowledge and expertise in technology and about the products used in the solution, in addition to extensive knowledge of the customers. Paper 1 shows that the local units work with the technology by configuring or developing their own products and technology to respond to customers' demands. While the front-end and back-end units have different main goals, as Miller et al. (2002) and Galbraith (2002) argue, these aims are overlapping and related. It has been argued that manufacturers need to develop capabilities to enhance the interactions between local units and the headquarters' R&D (Parida et al., 2015). The findings from the study in paper 1 are in line with this argument and highlight that product development is affected by the provision of integrated solutions because they involve local units' knowledge and services, but depend on the central product development organisation as well. A major implication for the product development organisation is that the competences for globally and locally made development change and overlap in the move to integrated solutions. This makes the development of integrated solutions increasingly complex. While the main focus of the central unit might be to develop capabilities and solutions for the future, and for local units to face the customers, but the development requires interaction between those. Further, the local and central units are in need of overlapping capabilities and knowledge in order to facilitate an integrated solution. Efforts are hence needed to manage the central and local technology development and configuration as discussed in Paper 1. The organisation is complex and solutions development rather than being isolated is distributed among the local units and the global product development organisation. Paper 1 shows that the move into the provision of integrated solution results in a greater need for local adaption to the customer's context. Since sales and service personnel are knowledgeable about customers, configuration of and adaption to solutions needs to be located close to these units. Paper 2 suggests that integration can be perceived as a service to achieve an adapted solution. However, as integration in customers' systems often involves technology and the integration between software and hardware, local units therefore also need extensive technical knowledge.

Parida et al. (2015) point out the lack of ways to include regional needs in the development process as a major challenge. Paper 1 suggests that while local units have knowledge of customers' current needs and business, the central development function is responsible for researching future trends and needs. While important, it is also difficult due to the different lead times of products and services as shown in Paper 3. In order to be able to start development of an integrated solution that is aiming to improve future customer operations, it is necessary to stay ahead of the customer. Hardware can have long development lead times, while other components can be developed more rapidly as shown in Paper 3. Company Gamma in Paper 3

said that hardware and software components have to be planned years in advance in order to be able to offer customer functionality. The issue of development lead times for hardware, software and services is related also to the localisation of development, and the challenge of including regional needs in the central development process. Hence, due to the issue of time, this integration is challenging.

Although it is argued that the value proposition is changing and there is move towards integrated solutions, the development of a proposition is fundamental (Brady et al., 2005) and the process involves both local and global development efforts. This is discussed in Paper 1 and described also partly by Brady et al. (2005) discussing the need for cross-functionality in the development of a proposal. The findings in Papers 1 and 3 suggest that for the development organisation, cross-functionality does not simply concern technology and customer knowledge; it also involves the integration of the central and several local units in the development process. Understanding the customer includes understanding its current needs and its market and business. While knowledge of current needs often exists in the local units, knowledge of the overall market, the customer's business and future needs often reside in the central organisation. This has implications for organising product development, the knowledge that is needed locally and centrally, and the need for coordination and the involvement of various in-house actors.

6. Conclusions and future research

This thesis research set out to investigate managerial challenges related to the development of integrated solutions. The conclusions from the research are in this chapter presented with the associated managerial implications and some suggestions for future research.

6.1. Conclusions

Based on the findings from this research there seem to be several managerial challenges related to the co-existence of integrated solutions and other offerings in the case companies. Firms need also to consider utilising and care for their valuable technology and the product knowledge as manufacturers. However, finding a balance among products, services and customers increases the complexity in the development. Further, the integration aspect related to the development and the need to balance standardisation and customisation in the provision of integrated solutions are challenging.

First, it can be argued that an integrated solution can be considered a business model (Wise and Baumgartner, 1999), but can also be described as an offering. Different integrated solutions address customers in different ways, and vary in their level of integration and customisation. It has been argued that companies provide several offerings simultaneously (Kowalkowski et al., 2015; Windahl, 2007; Windahl and Lakemond, 2010), and in order to adapt development to what needs to be developed, the integrated solution needs to be understood also as an individual offering. Hence, integrated solutions can be compared both between and within companies.

Many companies provide different kinds of offerings at the same time. These range from pure products, potentially with services as add-ons, to integrated solutions and pure services as suggested by Windahl (2007). The implications for managers from this and the different integrated solutions provided simultaneously include the need for an awareness of existing businesses and offerings when developing an integrated solution, especially considering the importance of the products and the technology as argued in this thesis. The move to provision of integrated solutions does not necessarily mean a transition away from products. Such a viewpoint is aligned with the argumentation by Johnstone et al. (2009), as it is not appropriate to view a move to integrated solutions as a transition from products to services.

Second, manufacturers have competitive advantages linked to their products and technological knowledge (Ulaga and Reinartz, 2011; Wise and Baumgartner, 1999). To develop integrated solutions, companies need not only to develop service capabilities but also to care for and develop their technological knowledge. Brax and Jonsson (2009, p. 555) point out that: ‘If the system fails, good service does not save the damage caused to the customer's business’. While previous research has argued the need to re-focus from products to service

and customers, future research and managers should also take into consideration the long-term effects of an over-emphasis on the customers' current needs.

Viewing the products with associated knowledge as resources, facilitates the development of valuable integrated solutions. The manufacturer can utilise its extensive knowledge of the technology, the product and customer use in developing an integrated solution. The product is a component of the solution and technological knowledge facilitates integration between components and systems. Thus, product and technology knowledge are fundamental resources for manufacturers moving into provision of integrated solution, which can create competitive advantage and should be nurtured. Offering integrated solutions does not mean abandoning a product focus and becoming a service provider; it means considering both products and customers alike. This thesis concurs with Brax and Jonsson (2009) that there is a need for excellence in managing both of these aspects in the development of integrated solutions; however, this makes the development more complex.

Third, development of integrated solutions involves challenges associated to adding services, but primarily with integrating products and services. It is this integration that allows the value surplus, which is value higher than what would have been achieved by each of the components separately or combined rather than integrated. While integration can be commercial or technical, it is the latter type which seems beneficial to create a bigger value surplus in relation to customers' operations. Integration is facilitated by the manufacturer's knowledge base and requires collaboration among organisational functions in the development of a solution (Parida et al., 2014; Windahl et al., 2004). The localisation aspect is however an important issue regarding integration and collaboration among functions. Integration puts demands on development: which function should be responsible for integrating the separate development streams and dealing with multiple perspectives and time horizons? The inclusion in the development of hardware, software and services of components with different development lead times, adds to this complexity.

Fourth, the existence of several different integrated solutions within a company poses problems related to managing the company solutions portfolio. Although it is argued that individual integrated solutions need to be tailored to the individual customer, manufacturers have to balance this with the need for some standardisation, important for creating repeatable solutions (Davies and Brady, 2000). In the move to providing integrated solutions, manufacturers must be aware that it may not be desirable to develop completely unique solutions for every customer. Managers need to develop a strategy to balance the need for standardisation and customisation. While platform and modular strategies commonly are applied to the development of products to deal with the need for customisation and standardisation, the development of integrated solutions imposes additional demands. Identifying a strategy to deal with a solutions portfolio requires a different perspective to assess which assets could be shared among various integrated solutions.

Although to an extent integrated solutions are adapted to the context in which they operate, this does not mean that all of their components have to be unique. What is important is that the customer perceives the solution as adapted to its setting and as fulfilling its needs.

As a result of these findings, a refined definition of an integrated solution can be proposed:

An integrated solution is an integrated set of products and services which, through the use of technology knowledge, facilitates the creation of a value surplus in relation to the customer's operational needs.

This defines an integrated solution as an offering and each company can develop several different offerings simultaneously. This definition also highlights the need to nurture and utilise the manufacturer's competitive resources, including the technology and associated knowledge. Integration enables a value surplus in the customers' operations. Note that an integrated solution is not defined as unique; companies must balance the need for customisation and standardisation. The co-existence of integrated solutions in a company, the utilisation of technology knowledge, integration, and the need to balance customisation and standardisation are the managerial challenges that must be dealt with to enable effective development of integrated solutions.

6.2. Future research

The research and its findings suggest directions for future research. It has been shown that many of the managerial challenges related to the development of integrated solutions emerge from the co-existence in the same company of more than one integrated solution, which requires a balance between standardisation and customisation. Further, the integration aspect is challenging and so is the utilisation of the products and the technology knowledge. At the level of the individual integrated solution, research could investigate integration in more depth. It could also examine the utilisation of knowledge in the development of an integrated solution, including how this knowledge should be shared among functions, locations and projects. More work is need on the management of the solutions portfolio and the portfolio of pure products and services provided in parallel. An interesting research direction would be, in relation to servitization and the need for internal coordination and integration in the business move, to examine the strategy alignment among various aspects and functions involved in the development of an integrated solution. This thesis research focused on intra-organisational challenges; however, inter-organisational issues, including relationships with external actors, should also be considered. These business relationships in the development of integrated solutions would be an interesting area for future research.

The development project

To facilitate the integration of components and development processes, future research could try to find ways to avoid and reduce the barriers to integration. One such barrier is associated to knowledge. While the

role of knowledge in the development and provision of integrated solutions has been emphasised, what this knowledge means for development is largely unknown. Knowledge sharing among individuals, functions and actors needs to be managed. This might result in a more integrated process of development related to integrated solutions. A potential area for future research might be a closer examination of the role of knowledge and knowledge sharing in the development of integrated solutions. In this context, Valtakoski (2016) proposes the knowledge-based view to understand integrated solutions and servitization.

Several challenges associated to integration were identified in this thesis, including the problems related to separate and sub-optimising organisational functions, different product and service lead times and formal processes for separate uncoordinated services and product development processes. Those areas would benefit from more in-depth investigation. How integration is managed also requires more investigation in order to provide guidelines and proposals for managers working with solution development projects.

Solutions portfolio

There are several problems related to the management of more than one integrated solution within a company. It requires various perspectives to be balanced and management of the solutions portfolio. This includes customisation and standardisation and the increased complexity in managing the solutions portfolio when not all the integrated solutions target the same needs and operations, and are integrated to different degrees. Some integrated solutions might require a great deal of customisation; others might depend on a standardised solution to facilitate value creation for the customer. The standardised solutions in such cases are providing best practice benchmarks. Modular strategies and the development of modular units and offerings have been proposed to provide different integrated solutions that include various, standardised components. This thesis identified the alternative of platform strategies. However, what to standardise and what to customise requires more research. Modular and platform strategies are derived from the development of physical products and are rooted in work on new product development, while research on service provision being more influenced by the marketing paradigm. This can cause tensions and complexity, which suggests more work on customisation and standardisation to understand what is, what should and could be shared among solutions.

Strategy alignment

This thesis research originated in part from the fact that, despite the benefits of and rationale for moving into solutions provision, many companies fail. The present research focused on managerial challenges related to the development of integrated solutions, but there are challenges for manufacturers moving into solution provision related also to strategic alignment (Martinez et al., 2010). Alghisi and Saccani (2015) highlight two points of alignment regarding internal aspects in servitization. The first is the alignment between the firm's strategic orientation and its portfolio of offers; the second is between the strategic

orientation and the firm's internal organisation (Alghisi and Saccani, 2015). These are related to the managerial challenges related to the development identified in this thesis. In the case of integrated solutions which have a high degree of integration between components, functions and the development processes, strategic alignment between various functions and management could be influenced. Future research could therefore examine the alignment between the proposed formal strategy and the operational processes and activities in the development organisation. How do various functions interpret, perceive and contribute to the solution strategy? What needs to be developed as a result? These insights could contribute to a better understanding of why companies fail or succeed in the move into integrated solutions in particular.

Business relationships

This research investigated managerial challenges related to the development of integrated solutions. While argued that there exist challenges related to relationships and partnerships when developing integrated solutions (Windahl, 2007; Windahl et al., 2004), this research focused on internal aspects. However, the external aspects require more research. While previous research highlights the need for more customer-centric and closer, long-term customer relationships (Baines et al., 2009; Galbraith, 2002; Vandermerwe and Rada, 1988), Windahl and Lakemond (2006) point to the importance of facilitating links between various partners in the business network, not just between customer and supplier. Managing these relationships with other parties is difficult and it is argued that the changed relationship between customer and company is not reflected directly in the relationships with the companies' suppliers (Martinez et al., 2010), which can prevent development and delivery of the integrated solution. It can be argued that business relationships can be the basis for competitive advantage in the provision of solutions (Eloranta and Turunen, 2015). The need for partnerships and the development of closer relationships with external parties was identified by the thesis case companies as allowing delivery of integrated solutions that target customers' overall needs. The case companies also highlight the need for collaboration to access product-associated resources such as new technology and product components. The need for resource expansion in provision of solutions is identified by Salonen and Jaakkola (2015), who highlight the lack of attention paid to accessing product-related resources in the literature where the focus, generally, is on the resources regarding the service components of the offering. Future research on business relationships in the development of integrated solutions, following the logic by Windahl and Lakemond (2006), might be beneficial for providing insights into how development of integrated solutions comprising both internally and externally developed components could be facilitated. A potential research direction would be to investigate the development of a relationship and a knowledge platform, as proposed in Paper 3.

References

Alghisi, A., and Saccani, N. (2015), "Internal and external alignment in the servitization journey – overcoming the challenges", *Production Planning & Control*, Vol. 26, No. 14-15, pp. 1219-1232.

Baines, T. S., and Lightfoot, H. W. (2013). *Made to serve: how manufacturers can compete through servitization and product service systems*. Chichester, West Sussex: John Wiley & Sons Ltd.

Baines, T. S., Lightfoot, H. W., Benedettini, O., and Kay, J. M. (2009), "The servitization of manufacturing: A review of literature and reflection on future challenges", *Journal of Manufacturing Technology Management*, Vol. 20, No. 5, pp. 547-567.

Barney, J. (1991), "Firm resources and sustained competitive advantage", *Journal of Management*, Vol. 17, No. 1, pp. 99-120.

Barney, J. (1995), "Looking inside for Competitive Advantage", *The Academy of Management Executive (1993-2005)*, Vol. 9, No. 4, pp. 49-61

Benedettini, O., Neely, A., and Swink, M. (2015), "Why do servitized firms fail? A risk-based explanation", *International Journal of Operations & Production Management*, Vol. 35, No. 6, pp. 946-979.

Brady, T., Davies, A., and Gann, D. M. (2005), "Creating value by delivering integrated solutions", *International Journal of Project Management*, Vol. 23, No. 5, pp. 360-365.

Brax, S. (2005), "A manufacturer becoming service provider – challenges and a paradox", *Managing Service Quality: An International Journal*, Vol. 15, No. 2, pp. 142-155.

Brax, S., and Jonsson, K. (2009), "Developing integrated solution offerings for remote diagnostics: a comparative case study of two manufacturers", *International Journal of Operations & Production Management*, Vol. 29, No. 5, pp. 539-560.

Bryman, A., and Bell, E. (2011). *Business Research Methods* (3 ed.). New York: Oxford University Press Inc.

Ceci, F., and Masini, A. (2011), "Balancing specialized and generic capabilities in the provision of integrated solutions", *Industrial and Corporate Change*, Vol. 20, No. 1, pp. 91-131.

Collin, P. H. (2006). *Dictionary of business* (4 ed. [reprint]). London: A & C Black Publishers Ltd.

Davies, A. (2004), "Moving base into high-value integrated solutions: a value stream approach", *Industrial and Corporate Change*, Vol. 13, No. 5, pp. 727-756.

Davies, A., and Brady, T. (2000), "Organisational capabilities and learning in complex product systems: towards repeatable solutions", *Research Policy*, Vol. 29, No. 7, pp. 931-953.

Davies, A., Brady, T., and Hobday, M. (2006), "Charting a path toward integrated solutions", *MIT Sloan Management Review*, Vol. 47, No. 3, pp. 39-48.

Davies, A., Brady, T., and Hobday, M. (2007), "Organizing for solutions: Systems seller vs. systems integrator", *Industrial Marketing Management*, Vol. 36, No. 2, pp. 183-193.

Dubois, A., and Araujo, L. (2007), "Case research in purchasing and supply management: opportunities and challenges", *Journal of Purchasing and Supply Management*, Vol. 13, No. 3, pp. 170-181.

Edmondson, A. C., and McManus, S. E. (2007), "Methodological Fit in Management Field Research", *The Academy of Management Review*, Vol. 32, No. 4, pp. 1155-1179.

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

Eisenhardt, K. M., and Graebner, M. E. (2007), "Theory Building from Cases: Opportunities and Challenges", *The Academy of Management Journal*, Vol. 50, No. 1, pp. 25-32.

Eloranta, V., and Turunen, T. (2015), "Seeking competitive advantage with service infusion: a systematic literature review", *Journal of Service Management*, Vol. 26, No. 3, pp. 394-425.

Eloranta, V., and Turunen, T. (2016), "Platforms in service-driven manufacturing: Leveraging complexity by connecting, sharing, and integrating", *Industrial Marketing Management*, Vol. 55, No., pp. 178-186.

Evanschitzky, H., Wangenheim, F. V., and Woisetschläger, D. M. (2011), "Service & solution innovation: Overview and research agenda", *Industrial Marketing Management*, Vol. 40, No. 5, pp. 657-660.

Flick, U. (2014). *An introduction to qualitative research* (5 ed.). London: SAGE Publications Ltd.

Galbraith, J. R. (2002), "Organizing to Deliver Solutions", *Organizational Dynamics*, Vol. 31, No. 2, pp. 194-207.

Grönroos, C. (2011), "Value co-creation in service logic: A critical analysis", *Marketing Theory*, Vol. 11, No. 3, pp. 279-301.

Halldorsson, A., and Aastrup, J. (2003), "Quality criteria for qualitative inquiries in logistics", *European Journal of Operational Research*, Vol. 144, No. 2, pp. 321-332.

Hobday, M. (1998), "Product complexity, innovation and industrial organisation", *Research Policy*, Vol. 26, No. 6, pp. 689-710.

Johansson, J. E., Krishnamurthy, C., and Schlissberg, H. E. (2003), "Solving the solutions problem", *McKinsey Quarterly*, Vol. No. 3, pp. 116-125.

Johnstone, S., Dainty, A., and Wilkinson, A. (2009), "Integrating products and services through life: an aerospace experience", *International Journal of Operations & Production Management*, Vol. 29, No. 5, pp. 520-538.

Jovanovic, M., Engwall, M., and Jerbrant, A. (2016), "Matching Service Offerings and Product Operations: A Key to Servitization Success: Existing conditions, such as product characteristics or market attributes, may determine the success of a move toward servitization", *Research-Technology Management*, Vol. 59, No. 3, pp. 29-36.

Kim, S.-H., Cohen, M. A., and Netessine, S. (2007), "Performance contracting in after-sales service supply chains", *Management Science*, Vol. 53, No. 12, pp. 1843-1858.

Kindström, D., Kowalkowski, C., and Alejandro, T. B. (2015), "Adding services to product-based portfolios: An exploration of the implications for the sales function", *Journal of Service Management*, Vol. 26, No. 3, pp. 372.

Kowalkowski, C., Windahl, C., Kindström, D., and Gebauer, H. (2015), "What service transition? Rethinking established assumptions about manufacturers' service-led growth strategies", *Industrial Marketing Management*, Vol. 45, pp. 59-69.

Kumar, R., and Kumar, U. (2004), "A conceptual framework for the development of a service delivery strategy for industrial systems and products", *Journal of Business & Industrial Marketing*, Vol. 19, No. 5, pp. 310-319.

Law, J. (Ed.) (2016) A dictionary of business and management (e-book collection) (6 ed.). Oxford: Oxford University Press.

Le Meunier-FitzHugh, K., Baumann, J., Palmer, R., and Wilson, H. (2011), "The Implications of Service-Dominant Logic and Integrated Solutions on the Sales Function", *Journal of Marketing Theory & Practice*, Vol. 19, No. 4, pp. 423-440.

Levitt, T. (1972), "Production-line approach to service", *Harvard Business Review*, Vol. 50, No. 5, pp. 41-52.

Lusch, R. F., and Vargo, S. L. (2014). *Service-dominant logic: Premises, perspectives, possibilities*: Cambridge University Press.

Martinez, V., Bastl, M., Kingston, J., and Evans, S. (2010), "Challenges in transforming manufacturing organisations into product-service providers", *Journal of Manufacturing Technology Management*, Vol. 21, No. 4, pp. 449-469.

Mathieu, V. (2001a), "Product services: from a service supporting the product to a service supporting the client", *Journal of Business & Industrial Marketing*, Vol. 16, No. 1, pp. 39-61.

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

Matthyssens, P., and Vandenbempt, K. (2008), "Moving from basic offerings to value-added solutions: Strategies, barriers and alignment", *Industrial Marketing Management*, Vol. 37, No. 3, pp. 316-328.

Maxwell, J. A. (2012). *Qualitative research design: An interactive approach* (3 ed.). Thousand Oaks, CA: SAGE Publications, Inc.

Miles, M. B., and Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (2 ed.). Thousand Oaks, CA: SAGE Publications, Inc.

Miles, M. B., Huberman, A. M., and Saldaña, J. (2013). *Qualitative data analysis: A methods sourcebook* (3 ed.). Thousand Oaks, CA: SAGE Publications, Inc.

Miller, D., Hope, Q., Eisenstat, R., Foote, N., and Galbraith, J. (2002), "The problem of solutions: Balancing clients and capabilities", *Business Horizons*, Vol. 45, No. 2, pp. 3-12.

Mont, O. K. (2002), "Clarifying the concept of product–service system", *Journal of Cleaner Production*, Vol. 10, No. 3, pp. 237-245.

Neu, W. A., and Brown, S. W. (2005), "Forming successful business-to-business services in goods-dominant firms", *Journal of Service Research*, Vol. 8, No. 1, pp. 3-17.

Nordin, F., and Kowalkowski, C. (2010), "Solutions offerings: a critical review and reconceptualisation", *Journal of Service Management*, Vol. 21, No. 4, pp. 441-459.

Nordin, F., Lindahl, I., and Brege, S (2013), "The Applicability of Integrated Solutions Offerings: Differential Effects of Product Complexity", *Journal of Relationship Marketing*, Vol. 12, No. 1, pp. 59-78.

Oliva, R., Gebauer, H., and Brann, J. M. (2012), "Separate or Integrate? Assessing the Impact of Separation Between Product and Service Business on Service Performance in Product Manufacturing Firms", *Journal of Business-to-Business Marketing*, Vol. 19, No. 4, pp. 309-334.

Oliva, R., and Kallenberg, R. (2003), "Managing the transition from products to services", *International Journal of Service Industry Management*, Vol. 14, No. 2, pp. 160-172.

Parida, V., Ronnberg-Sjodin, D., Wincent, J., and Kohtamaki, M. (2014), "Mastering the Transition to Product-Service Provision Insights into Business Models, Learning Activities, and Capabilities", *Research-Technology Management*, Vol. 57, No. 3, pp. 44-52.

Parida, V., Ronnberg-Sjodin, D., Lenka, S., and Wincent, J. (2015), "Developing Global Service Innovation Capabilities How Global Manufacturers Address the Challenges of Market Heterogeneity", *Research-Technology Management*, Vol. 58, No. 5, pp. 35-44.

Park, Y., Geum, Y., and Lee, H. (2012), "Toward integration of products and services: Taxonomy and typology", *Journal of Engineering and Technology Management*, Vol. 29, No. 4, pp. 528-545.

Pounds, W. F. (1969). 'The process of problem finding', *Industrial Management Review*, Vol. 11, No. 1, pp. 1- 19.

Raddats, C., Baines, T., Burton, J., Story, V. M., and Zolkiewski, J. (2016), "Motivations for servitization: the impact of product complexity", *International Journal of Operations & Production Management*, Vol. 36, No. 5, pp. 572-591.

Rathmell, J. M. (1966), "What is meant by services?", *Journal of Marketing*, Vol. 30 (October), pp. 32-36.

Robertson, D., and Ulrich, K. (1998), "Platform product development", *Sloan Management Review*, Vol. 39, No. 4, pp. 19-31.

Saldaña, J. (2015). *The coding manual for qualitative researchers* (3 ed.). London: SAGE Publications Ltd.

Salonen, A. (2011), "Service transition strategies of industrial manufacturers", *Industrial Marketing Management*, Vol. 40, No. 5, pp. 683-690.

Salonen, A., and Jaakkola, E. (2015), "Firm boundary decisions in solution business: Examining internal vs. external resource integration", *Industrial Marketing Management*, Vol. 51, pp. 171-183.

Schmenner, R. W. (2009), "Manufacturing, service, and their integration: some history and theory", *International Journal of Operations & Production Management*, Vol. 29, No. 5, pp. 431-443.

Shankar, V., Berry, L. L., and Dotzel, T. (2009), "A Practical Guide to Combining Products + Services", *Harvard Business Review*, Vol. 87, No. 11, pp. 94-99.

Shelton, R. (2009), "Integrating Product and Service Innovation", *Research-Technology Management*, Vol. 52, No. 3, pp. 38-44.

Shepherd, C., and Ahmed, P. K. (2000), "From product innovation to solutions innovation: a new paradigm for competitive advantage", *European Journal of Innovation Management*, Vol. 3, No. 2, pp. 100-106.

Slack, N., Brandon-Jones, A., and Johnston, R. (2013). *Operations Management* (7 ed.). Harlow, United Kingdom: Pearson Education Limited.

Stevenson, A. (Ed.) (2010) Oxford dictionary of English (3 ed.). New York, NY: Oxford University Press

Storbacka, K. (2011), "A solution business model: Capabilities and management practices for integrated solutions", *Industrial Marketing Management*, Vol. 40, No. 5, pp. 699-711.

Story, V. M., Raddats, C., Burton, J., Zolkiewski, J., and Baines, T. (2016), "Capabilities for advanced services: A multi-actor perspective", *Industrial Marketing Management*, Published online DOI: dx.doi.org/10.1016/j.indmarman.2016.04.015

Stremersch, S., Wuyts, S., and Frambach, R. T. (2001), "The Purchasing of Full-Service Contracts: An Exploratory Study within the Industrial Maintenance Market", *Industrial Marketing Management*, Vol. 30, No. 1, pp. 1-12.

Suarez, F. F., Cusumano, M. A., and Kahl, S. J. (2013), "Services and the Business Models of Product Firms: An Empirical Analysis of the Software Industry", *Management Science*, Vol. 59, No. 2, pp. 420-435.

Ulaga, W., and Reinartz, W. J. (2011), "Hybrid Offerings: How Manufacturing Firms Combine Goods and Services Successfully", *Journal of Marketing*, Vol. 75, No. 6, pp. 5-23.

Valtakoski, A. (2016), "Explaining servitization failure and deservitization: A knowledge-based perspective", *Industrial Marketing Management*, Published online DOI: dx.doi.org/10.1016/j.indmarman.2016.04.009

Vandermerwe, S., and Rada, J. (1988), "Servitization of business: Adding value by adding services", *European Management Journal*, Vol. 6, No. 4, pp. 314-324.

Vargo, S. L., and Akaka, M. A. (2009), "Service-dominant logic as a foundation for service science: clarifications", *Service Science*, Vol. 1, No. 1, pp. 32-41.

Vargo, S. L., and Lusch, R. F. (2004a), "Evolving to a New Dominant Logic for Marketing", *Journal of Marketing*, Vol. 68, No. 1, pp. 1-17.

Vargo, S. L., and Lusch, R. F. (2004b), "The four service marketing myths remnants of a goods-based, manufacturing model", *Journal of Service Research*, Vol. 6, No. 4, pp. 324-335.

Velamuri, V. K., Neyer, A.-K., and Möslein, K. M. (2011), "Hybrid value creation: a systematic review of an evolving research area", *Journal für Betriebswirtschaft*, Vol. 61, No. 1, pp. 3-35.

Visintin, F. (2012), "Providing integrated solutions in the professional printing industry: The case of Océ", *Computers in Industry*, Vol. 63, No. 4, pp. 379-388.

Visnjic Kastalli, I., and Van Looy, B. (2013), "Servitization: Disentangling the impact of service business model innovation on manufacturing firm performance", *Journal of Operations Management*, Vol. 31, No. 4, pp. 169-180.

Visnjic, I., Wiengarten, F., and Neely, A. (2016), "Only the Brave: Product Innovation, Service Business Model Innovation, and Their Impact on Performance", *Journal of Product Innovation Management*, Vol. 33, No. 1, pp. 36-52.

Voss, C., Tsikriktsis, N., and Frohlich, M. (2002), "Case research in operations management", *International Journal of Operations & Production Management*, Vol. 22, No. 2, pp. 195-219.

Wernerfelt, B. (1984), "A resource-based view of the firm", *Strategic Management Journal*, Vol. 5, No. 2, pp. 171-180.

Windahl, C. (2007). *Integrated Solutions in the Capital Goods Sector: Exploring innovation, service and network perspectives.* Doctoral Dissertation, Linköping Studies in Science and Technology, Linköping University, Linköping

Windahl, C. (2015), "Understanding solutions as technology-driven business innovations", *Journal of Business & Industrial Marketing*, Vol. 30, No. 3/4, pp. 378-393.

Windahl, C., Andersson, P., Berggren, C., and Nehler, C. (2004), "Manufacturing firms and integrated solutions: characteristics and implications", *European Journal of Innovation Management*, Vol. 7, No. 3, pp. 218-228.

Windahl, C., and Lakemond, N. (2006), "Developing integrated solutions: The importance of relationships within the network", *Industrial Marketing Management*, Vol. 35, No. 7, pp. 806-818.

Windahl, C., and Lakemond, N. (2010), "Integrated solutions from a service-centered perspective: Applicability and limitations in the capital goods industry", *Industrial Marketing Management*, Vol. 39, No. 8, pp. 1278-1290.

Wise, R., and Baumgartner, P. (1999), "Go Downstream: The New Profit Imperative in Manufacturing", *Harvard Business Review*, Vol. 77, No. 5, pp. 133-141.

Zeithaml, V. A., Parasuraman, A., and Berry, L. L. (1985), "Problems and strategies in services marketing", *Journal of Marketing*, Vol. 49 (Spring), pp. 33-46.