

MASTER

Capability development within solution providers
capabilities developed within the R&D department of solution providers

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Capability development within solution providers;
capabilities developed within the R&D department of
solution providers

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in partial fulfilment of the requirements for the degree of

Master of Science

in Innovation Sciences & Innovation Management

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II. Preface

This research paper is presented and written as my graduation project for a dual degree in both Innovation Sciences as Innovation Management at the Eindhoven University of Technology. The journey towards graduating both masters has been challenging at times, but it was also gratifying. With regards to my graduation project, I can safely say it has been a struggle, but I believe the result is one to be proud of and worthy of a dual degree at the TU/e.

Then, I would like to express my gratefulness to my supervisors Carolina Castaldi and Ed Nijssen. Both of them offered great insights from the different masters' perspectives while keeping the end result of the project in mind. They offered useful advice needed for redirecting my research and to guarantee a worthy master thesis, which is translated in the result of this thesis.

To conclude this dual degree, I've had the opportunity to assist in the knowledge development of one of the most prestigious Dutch technological companies. Therefore, I would like to express my gratefulness towards Company X and especially my supervisor there, [REDACTED]. [REDACTED] has trusted me with freedom, and sometimes guidance, in developing and finishing my thesis. By also providing contact information for people to participate in my data collection, I could successfully perform my data collection with highly placed managers.

Then, I would like to acknowledge my colleague in both the research at Company X and my studies at the TU/e, Vincent van Gils. Without his friendship, guidance and strong opinionated discussions about study related subjects I would not have been able to finish this dual degree, at least not with this much fun.

Finally, I would like to thank my family and my girlfriend for their never doubting me, even in the times of uncertainty. They offered me support when I needed it, and motivated me to finish my thesis.

1. Summary

Product markets are getting increasingly competitive resulting in lower prices and lower profit margins. Manufacturers are scrambling to react and many firms pursue adding services to their products to gain competitive advantage, a so-called servitization strategy (Matthyssens & Vandenbempt 2008; Mathieu 2001a; Baines et al. 2009). Studies have shown the difficulties firms face when pursuing a servitization strategy (Baines et al. 2009; Vandermerwe & Rada 1988; Marks et al. 2011). In short, firms need to restructure and redevelop themselves through several steps (Davies et al. 2006). In this new organizational structure the literature defines three parts: front-end, back-end and a strategic center (Davies et al. 2006; Foote et al. 2001). In this organizational structure the front-end functions as the customer-facing unit while the back-end is responsible for developing solutions, or standardized components that can be used within solutions (Davies et al. 2006).

The literature aimed at explaining which capabilities solution providers have developed offers insights from two perspectives: the firm as a whole, and the front-end more in depth (Storbacka 2011; Brady et al. 2005; Ulaga & Reinartz 2011). Consequently, the back-end, responsible for an integral part of providing solutions (i.e. develop them), and which capabilities are developed there, has largely been ignored. This research paper provides a clear understanding on what capabilities solutions providers have developed in their (former) R&D department, or within the teams undertaking the innovative activities within the firm.

As is shown by Davies et al. (2006) and discussed by others (Foote et al. 2001; Galbraith 2002; Storbacka 2011; Pawar et al. 2009), a clear distinction is made between the Front-end and the Back-end within a solution providers' organizational structure. This is done by organizations to build themselves around their customers' current and future needs. Storbacka (2011) identified sixty four capabilities, categorized within the organizational structure of front-end, back-end and strategic center. Other studies, like that of Ulaga & Reinartz (2011) and that of Brady et al. (2005), have identified capabilities of manufacturers that transition towards solution providers and generic capabilities for solutions providers, respectively. All these capabilities have been combined and then distilled into eight distinct capabilities, four in the front-end and four in the back-end of the organization.

Continuing on the identification and explication of the capabilities developed within solution providers by Brady et al. (2005), Davies et al. (2006) and Storbacka (2011), capability dimensions have been interpreted, combining all three studies. These capability dimensions have been probed at 8 large corporations, and with 1 solution expert. This has been done through qualitative interviews, aimed at underpinning to what degree certain capability dimensions have been developed within the R&D department. But more importantly, a qualitative research process has been adopted to be able to identify possible *new* capabilities

that have been developed within R&D departments but have not, up till now, been identified in the literature. Based on those findings, conclusions have been drawn, arguing that *solution configuration & standardization*, *customer insight & deployment* and *communication* capability dimensions are the main dimensions that are developed within the R&D departments, or related teams. But most importantly, by identifying what capabilities are developed within a specific department, both firms and the solution literature are provide with a more concrete understanding of how these capabilities are situated within solutions providers.

Also, this paper has identified two specific capabilities that previous studies have missed, or ignored, in their research: *application knowledge development* and *networking capabilities*. These capabilities have been categorized within two dimensions, *customer insight & deployment* and *communication* respectively, expanding the existing literature with a more comprehensive perspective on the capabilities solution providers develop. According to some of the interviewed managers, these capabilities are also developed within their R&D departments, and are increasingly important with the move towards becoming a solution provider. Overall, this research continues on the importance of cross-functional alignment with firms, argued by Storbacka (2011), by extending the knowledge on the coordination of resources and business processes within the R&D departments, or related teams. Practically, this research offers managers with a concrete overview on what capabilities they should focus on developing within their R&D department, or related teams.

Finally, this paper offers suggestions for Company X to adopt a more customer-centric development culture, by improving the marketing-npd communication and cooperation channels and by developing capabilities within Company X, aimed at improving their ability to utilize customer insights in their development process.

2. Introduction

Product markets are getting increasingly competitive resulting in lower prices and lower profit margins. Manufacturers are scrambling to react and many firms pursue adding services to their products to gain competitive advantage (Matthyssens & Vandenbempt 2008; Mathieu 2001a; Baines et al. 2009). This process of combining services with products is not as straight-cut as it seems; new service-based and customer-centric business models need to be developed as the foundation of good product-service combinations (Baines et al. 2009; Vandermerwe & Rada 1988; Davies et al. 2006). More specifically, firms need to develop tailored combinations of products and services that fit with specific demands of large business and government customers. In current literature these combinations are known by several definitions with the most cited being 'integrated solutions' (Davies et al. 2001; Davies et al. 2006; Davies et al. 2007; Mathieu 2001a). Firms that provide these integrated solutions, also described as 'integrated solutions providers', essentially design and integrate components into a system, which is then complemented with services to operate, maintain and finance the system during its life cycle (Davies et al. 2006).

Integrated solutions as a business strategy are far from novel, since the 1960s firms have been adopting 'systems selling' strategies (Vandermerwe & Rada 1988). Systems selling can be described as "the provision of products and services and integrated systems that provide solutions to customer's operational needs". Since the introduction of systems selling, research has focused on many different aspects of solutions offerings: The capabilities firms should develop (Storbacka 2011; Brady et al. 2005; Ulaga & Reinartz 2011; Davies et al. 2006), difficulties associated with the transition toward becoming a solutions provider (Baines et al. 2009; Shepherd & Ahmed 2000; Matthyssens & Vandenbempt 2008; Kapletia & Probert 2010; Davies et al. 2001; Windahl et al. 2004), and the cycle firms move through while transitioning (Davies 2004; Matthyssens & Vandenbempt 2008; Davies et al. 2007; Brady et al. 2005; Davies et al. 2006). However, our understanding of the exact capabilities organizations need to develop is very limited, especially in terms of which capabilities are developed in which departments within the organization. This is exemplified by multiple studies that claim one of the barriers of becoming a solution provider is that managers don't know what capabilities to develop, and where to develop them (Ulaga & Reinartz 2011; Miller et al. 2002; Galbraith 2002; Kapletia & Probert 2010; Tuli et al. 2007; Matthyssens et al. 2009; Matthyssens & Vandenbempt 2008)

Studies have shown the difficulties firms face when pursuing a servitization strategy (Baines et al. 2009; Vandermerwe & Rada 1988; Marks et al. 2011). In short, firms need to restructure and redevelop themselves through several steps (Davies et al. 2006). In this new organizational structure the literature defines three parts: front-end, back-end and a strategic center (Davies et al. 2006; Foote et al. 2001). In this organizational structure the front-end

functions as the customer-facing unit while the back-end is responsible for developing solutions, or standardized components that can be used within solutions (Davies et al. 2006). According to Davies et al. (2006) the first step is strengthening the customer interaction (i.e. building the front-end), before developing capabilities specific for developing solutions (i.e. building the back-end).

While this paper, and my others alike, provide knowledge about solution providers in terms of structure and capabilities, they mainly focus on 'mature' solution providers. More specifically, previous studies offer insight into the organizational structure, and which capabilities are developed within that structure, of solutions providers that adopted the front-end, back-end structure. Consequently, firms attempting to adopt a servitization strategy still having a "traditional" organizational structure, have little use for that knowledge as they offer little help in understanding what capabilities firms should develop where in the organization. The literature aimed at explaining which capabilities solution providers have developed offers insights from two perspectives: the firm as a whole, and the front-end more in depth (Storbacka 2011; Brady et al. 2005; Ulaga & Reinartz 2011). Consequently, the back-end, responsible for an integral part of providing solutions (i.e. develop them), and which capabilities are developed there, has largely been ignored. This is surprising as multiple studies have stressed the need for an increased amount of knowledge on how companies can develop capabilities to move from basic products to integrated solutions (Storbacka 2011; Davies et al. 2006; Ceci & Masini 2011).

Continuing on this direction, the research development of products and technologies has traditionally been a function of the R&D department (Acha et al. 2005). The solution literature doesn't explicitly mentions an R&D department, as in the new organizational structure all tasks are performed by multi-disciplinary teams (Davies et al. 2006), but it *does* mention the main function of the back-end, namely developing solutions and/or the components for solutions (Storbacka 2011; Brady et al. 2005; Baines et al. 2009). Arguably the back-end performs a similar function as the traditional R&D department. Yet, the literature also argues that the research and development efforts need to be closer and react to market- and customer-needs (Biggemann et al. 2013; Ettl & Rosenthal 2011; Shepherd & Ahmed 2000; Kapletia & Probert 2010). Thus, the traditional R&D department is not *purely* back-end, as it needs to have a foot in the front-end as well. However, the literature on the capabilities within solution providers makes a clear distinction between front-end and back-end. Consequently, as the traditional R&D department functions both in the front-end as well as in the back-end, which capabilities are developed within this department, or within the teams performing innovative activities within the firm, remains elusive.

This research paper aims to provide exactly that: to generate a clear understanding on what capabilities solutions providers have developed in their (former) R&D department, or

within the teams undertaking the innovative activities within the firm. More precisely, the research question for this study is formulated as follows:

"What capabilities are developed within the R&D department, or within the teams that undertake the innovative activities within the firm, of solution providers, to successfully develop integrated solutions?"

By studying which capabilities are developed within R&D specifically, this research continues on the existing literature of integrated solutions, specifically regarding capability development, and contributes to a better understanding of which capabilities are developed within solution providers. More specifically, this paper places the capabilities identified in previous studies within the organizational context, specifically the R&D department, and studies what specific capabilities are developed there. Furthermore, managers are provided with concrete handles in their process towards becoming a solutions provider (Ulaga & Reinartz 2011; Davies et al. 2006). More specifically, managers are provided with in-depth knowledge on the exact capabilities solution providers have developed in their R&D departments. With that, managers are able to assess what capabilities are needed within their R&D departments, or teams undertaking the innovative activities, to match other solution providers.

This study is commissioned and supervised by Company X in [REDACTED]. As an initial step in the research process Company X has formulated a problem description combined with a preferred direction of this research paper. At the end of this paper, specific suggestions and implications will be provided with which Company X may solve their problem.

This paper is structured as follows. Following this introduction, the problem description from Company X is formulated. The conceptual background is explicated in section 3. Then, section 4 presents the research aim together with the conceptual model, developed based on the literature described in the conceptual background section. Third, the research process and the used methods are described in section 5. Section 6 presents the findings from the research followed by the conclusions from these findings in section 7. Finally, in section 8 the practical implications for Company X, followed by section 9 in which the contribution of the research and future research opportunities are discussed.

2.1 Problem description Company X

Company X has since it's been established focused purely on the manufacturing and the offering of products. At first these were mainly [REDACTED], but quickly Company X expanded into other product families. However, Company X is experiencing increasing competition from other manufacturers and is thus looking for other ways to improve their revenue. To this end,

Company X is exploring the possibilities of adding services to their products; [REDACTED]

However, Company X is inexperienced when it comes to service development and even more so when it comes to adding services to their existing product lines. Consequently, Company X is looking to expand their knowledge base on services. More specifically, Company X is interested in developing services and solutions in the near future but needs more knowledge on the requirements for their R&D department. To that end, Company X has hired several graduating interns, tasked with researching various aspects of solutions, servitization and value adding services.

Zooming in on this research paper, Company X has requested this paper to focus on what capabilities Research & Development departments, or teams that undertake the innovative activities within the firm, of organizations that already develop and offer solutions (i.e. product-service combinations) to their customers, have developed. More specifically, Company X is interested in identifying what capabilities their R&D department can develop in their process of becoming a solutions provider.

3. Conceptual Background

3.1 Servitization

3.1.1 Defining Servitization

According to the pioneering research on servitization, firms initially considered themselves focusing on either goods or services (e.g. a product manufacturer, like a toy manufacturer, or financial service provider, like a bank) and then start to transitioning to offering goods with services that are closely related, offering products with related services (e.g. maintenance or finance) (Vandermerwe & Rada 1988). Finally, these firms completely move into a strategy where “they offer ‘bundles’ that consist of customer focused combinations of goods, services, support, self-service and knowledge” (Vandermerwe & Rada 1988). The term servitization, introduced by Vandermerwe and Rada (1988), is being used increasingly as describing the process of creating value for manufacturers by adding services to products. Servitization has been defined as being “an increased offering of fuller market packagers or ‘bundles’ of customer focused combinations of goods, services, support, self-service and knowledge in order to add value to core product offerings” (Vandermerwe & Rada 1988). This definition is formulated from the perspective that services are performed and not produced, hence are essentially intangible. Over time, other definitions have been used but have always put the product-based services central. More recently, Baines et al. (2009) has redefined servitization as “the innovation of an organizations’ capabilities and processes to better create mutual value through a shift from selling product to selling product-service systems”.

Product-service systems, as used by Baines et al. (2009), is one of the many different definitions of a combination between products and services that can be developed and sold by firms who pursue a servitization strategy (Nordin & Kowalkowski 2010). Other frequently used formulations consist of *product-service combinations* (Marks et al. 2011), *hybrid offerings* (Ulaga & Reinartz 2011), *integrated solutions* (Brady et al. 2005) and *customer solutions* (Biggemann et al. 2013). In table 1 the perspectives in the subject-specific literature on the outcomes of a solutions offering are summarized. All these formulations share the aim of describing some form of combination between a tangible and manufactured product with a value adding service, to provide a higher customer value. This research paper uses the definition of Storbacka (2011) of *integrated solutions*, as this research paper continues on the findings of mainly that paper.

Source	Extract
Matthyssens and Vandembemt (1998)	Superior customer value: explicit service quality, proactive, total solution, and timely, empathic design of new services
Hax and Wilde (2001)	Improve customer economics and horizontal linkages in the components firm
Miller <i>et al.</i> (2002)	Solutions are about outcomes that make life easier or better for the client
Stremersch <i>et al.</i> (2001)	[...] offering full-service contracts will reduce competition due to the lower level of price transparency in the market, leading to higher margins
Johansson <i>et al.</i> (2003)	Total business value delivered
Brady <i>et al.</i> (2005a)	Providing combinations of products and services that create unique benefits for each customer, and developing new ways for components to work together as an integrated whole to increase the overall value
Sawhney <i>et al.</i> (2006)	To solve end-to-end customer problems
Tuli <i>et al.</i> (2007)	The purpose of a solution is to satisfy customer needs
Ceci and Prencipe (2008)	From the firms' point of view, offering a solution means solving a customer's problem; from the customers' point of view, buying an integrated solution represents outsourcing some activity and thereby focusing their own resources on their core business
Matthyssens and Vandembemt (2008)	To achieve non-price-based customer value addition

Table 1: Perspectives on the outcome of solutions based on Nordin & Kowalkowski (2010)

Besides the more generic literature on servitization, there is a trend in literature that focuses mainly on integrated solution (Storbacka 2011; Windahl & Lakemond 2006; Davies et al. 2001; Brady et al. 2005). From the literature, it becomes clear that no rigorous and unanimous definition of "solutions" exists, rather individual contributions offer broad descriptions that could apply to a wide array of different offerings, considered to be solutions. Nordin & Kowalkowski (2010) have illustrated the knowledge in a solutions framework, shown in figure 1. This framework summarizes significant contributions to the solutions knowledge and explains solutions across four dimensions: antecedents, characteristics of solutions, outcomes and process.

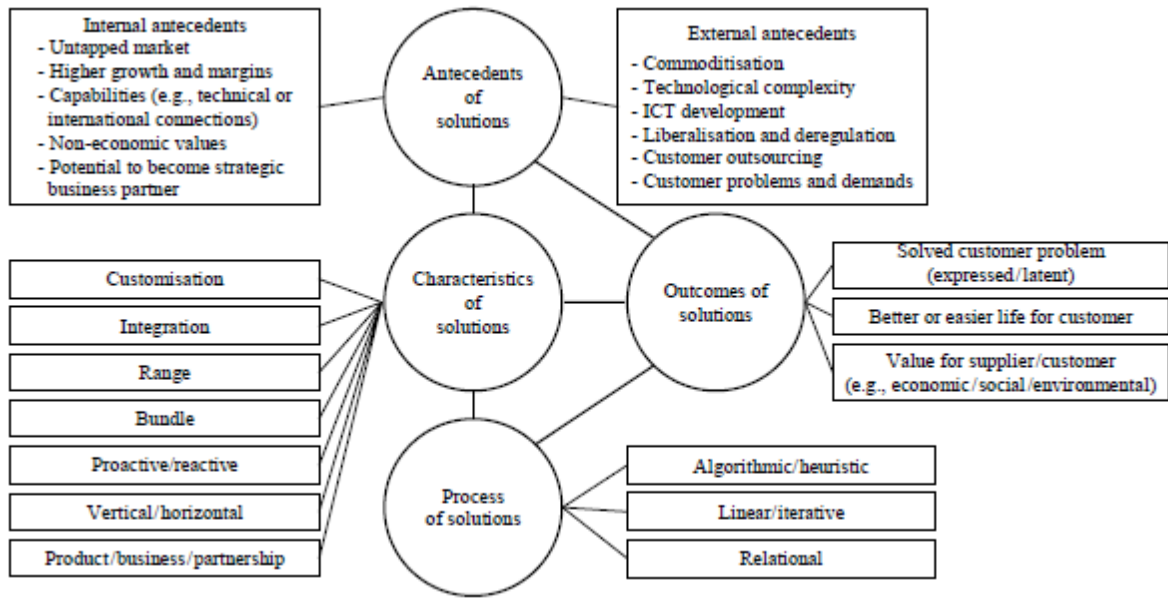


Figure 1: A solutions framework from Nordin & Kowalkowski (2010)

Since the introduction of the concept of servitization studies have been done aimed at understanding the implications and development of integrated solutions (Baines et al. 2009). The studies done on this concept signal a growing interest in servitization and argue that businesses' and governments' focus is shifting toward this concept. This is a result of the belief that moving in the direction of servitization is a mean to create additional value adding capabilities for product manufacturers (Baines et al. 2009). More specifically, opposite to normal *pure* products, firms that integrate services with their products, so-called product-service combinations, are more able to defend their offerings from competition as services are more difficult to replicate (Baines et al. 2009).

3.1.2 Features of Servitization

Traditionally manufacturers have viewed "services as a necessary evil"; products were the thing desired by consumers, whereas the services are merely an add-on needed to close the sales (Baines et al. 2009). More specifically, manufacturers offered services, yet strongly believed that the physical goods, i.e. the products, were the main element of the total created value. This view has drastically changed since then; services are now perceived as a main differentiating opportunity for totally integrated products and service offerings. Consequently, manufacturers view the development and services as a conscious and explicit strategy in order to gain competitive advantage. With this changed view manufacturers stop focusing on products alone but are becoming more customer-centered. More specifically, customers aren't offered mere products but are offered more tailored solutions. This can even result in some situations where

products from multiple vendors are combined to deliver the solution, also defined as “multi-vendor” solutions (Baines et al. 2009).

Oliva & Kallenberg (2003) describe this customer-centered strategy, prevalent with firms that offer solutions, as consisting out of two elements. First, the firm shifts from developing services related to products, as was traditional in the earlier periods where firms offered services as part of their product, toward “user’s processes oriented services”. More specifically, these are services that pursue efficiency and effectiveness of end-user’s processes related to the product, instead of services that ensure proper functioning or user experience in combination with the product. Secondly, the firm transitions toward a more relationship sustaining strategy regarding customer interaction. Simply put, firms abandon transaction-based customer interaction to pursue a relation-based interaction.

3.1.3 Drivers of Servitization

Throughout the literature there are three sets of factors that are identified as being drivers of servitization, i.e. factors that pushes firms to pursue a servitization strategy; these sets of factors have been identified as being “financial”, “strategic” in terms of competitive advantage, and “marketing” (Baines et al. 2009; Oliva & Kallenberg 2003; Gebauer et al. 2005).

Financial drivers

Literature describes the main financial drivers as higher profit margin and stability of income (Gebauer et al. 2005; Wise & Baumgartner 1999). More specifically, according to Wise & Baumgartner (1999) service revenues can be one or two times greater than new product sales. This is true, even more so for companies like GE, IBM, Siemens and Hewlett Packard, as they have successfully sustained stable revenues from services even though their sales volumes have dropped significantly (Baines et al. 2009).

Another financial driver can be found for manufacturers that produce products with increasingly longer life cycles, like airplanes or trains. Such complex products with long life-cycles pushes the revenue stream downwards into services, mainly in support. However, product-service combinations have shown to be less sensitive to price competition resulting in higher levels of profitability than product offerings alone (Malleret 2006). And the final financial driver is that product-service offerings seem to withstand economic cycles that affect investments and goods purchase, consequently making product-service offerings a way of securing a regular income while at the same time helps balancing the effects of mature markets or negative economic cycles.

Strategic drivers

The strategic drivers described in the literature are generally concerned with gaining competitive advantage. More specifically, the strategic drivers described refer to firms that use service elements to differentiate their goods offerings to provide important competitive opportunities (Gebauer et al. 2005). Traditionally, services are more difficult to imitate or replicate, because of their intangible and labor dependent nature, and with that offer a more sustainable advantage over the competition (Oliva & Kallenberg 2003; Gebauer et al. 2005).

This driver is amplified by the increasing commoditization of product markets resulting in price cutting and lower margins, as shown in figure 2. As some studies have argued, differentiation through product innovation, resulting in technological superiority, and process innovation, resulting in price cutting, offer less and less competitive advantage (Mathieu 2001b; Framback et al. 1997; Gebauer et al. 2005; Gebauer et al. 2006; Matthyssens & Vandenbempt 2008). Furthermore, Framback et al (1997) argue that the added value of services result in a change in perception, from the customer's perspective; through the addition of services, customers perceive their homogenous physical products as customized. Consequently, these aspects increase barriers to competitors (Mathieu 2001b).

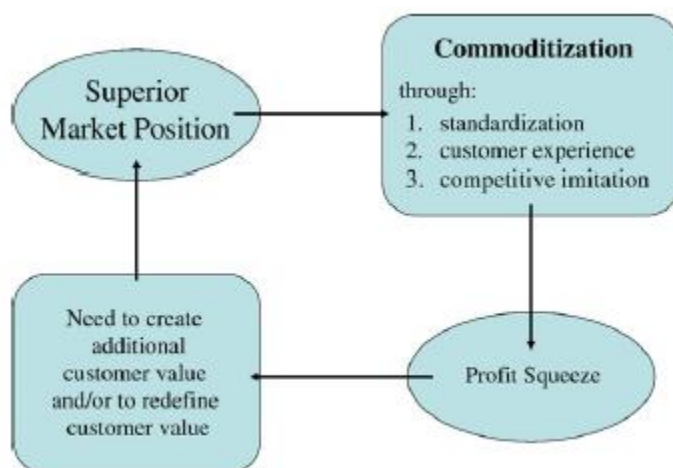


Figure 2: Commoditization cycle, according to (Matthyssens & Vandenbempt 2008)

Marketing drivers

Marketing related drivers can be better described as marketing opportunities that use services for selling more products (Gebauer et al. 2006). More specifically, adding a service component can greatly influence purchasing decisions, hence literature on marketing is studying the importance of added services (Mathieu 2001b). Adding services is even more important in the

“business-to-business” (B2B) market, or industrial market, where demands for services keep increasing (Vandermerwe & Rada 1988; Oliva & Kallenberg 2003). This increasing demand can be explained by the trend that organizations are getting more and more pressure to be flexible, resulting in more focused offerings and with that narrower definitions of the core competence while maintaining a high technological complexity. This trend results in firms requiring to outsource their services to their suppliers (Lewis et al. 2004; Slack 2005).

Another marketing drive refers to the interaction with the customer of the products. More specifically, by adding services to physical products organizations are argued to be creating customer loyalty (Vandermerwe & Rada 1988). This may even go up to the point where customers are becoming dependent on their supplier and with that induce repeated-sales (Mathieu 2001b). Arguably, a more important driver is the intensifying contact between the suppliers and their customers that added services offer. This results in a great opportunity for the suppliers to gain more insight into their customers’ needs and consequently offer other products or services while being able to develop even more tailored offerings (Mathieu 2001b; Baines et al. 2009).

3.1.4 Challenges of Servitization

Servitization may offer firms with many opportunities and could therefore be a desired strategy for many firms, however many challenges exist in the adoption of such a strategy. The literature has categorized these challenges into two broad categories: integrated product-service design/development, and organizational strategy and transformation (Baines et al. 2009; Oliva & Kallenberg 2003; Brax 2005; Slack 2005; Wise & Baumgartner 1999).

Integrated product-service development

Services are traditionally fuzzy and difficult to define and consequently they require a significantly different development and design process than regular products (Slack 2005). Consequently, this increases the difficulty for firms to expand their offerings toward the services dimension. Not only that, but firms face another challenge with regards to competition: firms need to consider unexpected rivals outside of their usual domain, which can also be their own suppliers, distributors or even customers (Vandermerwe & Rada 1988; Oliva & Kallenberg 2003). There is another risk involved in the design process as firms may encounter difficult challenges when attempting to offer services to substitute activities previously performed by their customers (Slack 2005). The marginal risk of these services may outweigh the benefits of an increase in profits and with that keep firms from pursuing a servitization strategy (Baines et al. 2009). And finally, in the entire process of development and sales, the communication strategy is crucial as firms need to be able to clearly describe the value proposition to the customer, which proves to be another challenge (Mathieu 2001a).

Organizational strategy and transformation

If and when organizations decide to pursue a servitization strategy, not only need they take all previously mentioned risks into account, they need to change their organizational structures and processes (Mathieu 2001b; Gebauer et al. 2005; Oliva & Kallenberg 2003). Naturally, changing an organizations structure and processes is accompanied by many challenges, in the case of servitization these challenges occur with defining the new organization strategy. More specifically, when pursuing servitization the organizations' strategy needs to be defined in such a way that it supports its customer allegiance required to deliver product-service combinations (Wise & Baumgartner 1999). This can be achieved by adopting a downstream position, such as the provision of installed base services, but for this service orientation and the valuation of services is needed (Oliva & Kallenberg 2003). These organizations offer product-service combinations as customized solutions and are shown to be customer-centered; they offer outcomes that customer desire instead of offering products that possibly might result in the desired outcome (Miller et al. 2002). From this school of thought, it is concluded in the literature that client partnering and expanding competences are crucial in providing these product-service combinations (Baines et al. 2009). Yet, management principles that are related to services are more often than not in contrast with traditional manufacturing practices, causing many related challenges (Mathieu 2001b).

One of these challenges is related to the organizational culture needed for effective servitization, which is significantly different from the traditional manufacturer culture (Mathieu 2001a; Mathieu 2001b). More specifically, priorities need to shift considerably to support service development instead of the usual ways of gaining competitive advantage, within product development (Oliva & Kallenberg 2003). The main shift, required for organizations that aspire servitization, is to abandon their product-centric culture, and with that their product-centric structure, and pursue a customer-centric culture (Foote et al. 2001). This shift proves difficult as organizational culture is embedded in the practices and attitudes that have been long-standing within the organization (Baines et al. 2009). More specifically, areas within the organizations that cannot relate to a service strategy become resistant because of a fear of infra-structural change (Mathieu 2001b). Consequently, crucial to this shift is finding a workforce fit for the service dimensions within the organization, while at the same time creating an environment that is more service-oriented. It is argued that when providing services, managers of manufacturers must change the perception within the organization that people are their main asset, not the products (Neely 2007). Gebauer et al. (2005) introduce the term *service paradox* that describes these challenges as explanation for the fact that firms that extend their service business leads to increased service offerings and higher costs, but not to correspondingly higher returns.

Davies et al. (2006) take it one step further, arguing that organizations that aim at becoming an integrated solutions provider must build their organizations around their customers' current and future needs. This new organization structure enables firms to provide tailored combinations of products and services as a solution to their problems. In short, this is a shift away from traditional structures organizations are used to. According to Davies et al. (2006) integrated solutions providers must have an organizational structure comprising of a front-end, which main function is communication with customers, a back-end, which entails of the capability providers and solution development, and a strong strategic center, which is responsible for managing the interaction between front- and back-end (figure 3) (Davies et al. 2007; Galbraith 2002; Davies et al. 2006).

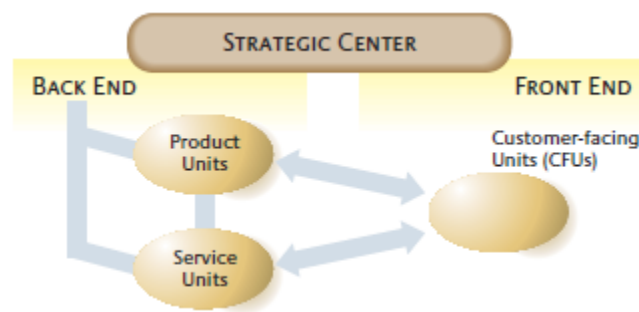


Figure 3: A three-part organizational structured, as described by Davies et al. (2006)

3.2 Capabilities

Competitive advantage, one of the main drivers for organizations to pursue a servitization strategy, is predominantly achieved by developing and deploying resources and capabilities (Ulaga & Reinartz 2011). Resources can be defined as the productive assets organizations own, like capital and real estate; capabilities can be defined as the things organizations can do. More specifically, an organizational capability can be defined as a "firm's capacity to deploy resources for a desired end result" (Helfat & Lieberman 2002).

3.2.1 Categories

According Davies et al. (2006) the first priority of an organization, pursuing the offering of solutions, must be having a clear understanding of their strengths and what capabilities to develop. Organizations that shift toward becoming an integrated solutions provider have shown to develop a number of new capabilities, which are categorized as follows (Brady et al. 2005; Ulaga & Reinartz 2011; Davies et al. 2006). These four main categories return in all other studies that describe the capabilities needed within a solutions provider (Miller et al. 2002; Ceci & Masini 2011; Storbacka 2011; Ulaga & Reinartz 2011).

- *System integration capabilities* – Capabilities to design and integrate systems that are composed of internally and externally developed hardware, software and services.
- *Operational service capabilities* – Capabilities to maintain, operate, upgrade and renovate a product through its operational life cycle.
- *Business consulting capabilities* – Capabilities to provide customers with advice on how to develop business plans, design and build a system and maintain and operate it.
- *Financing capabilities* – Capabilities to help customers purchase high-cost products and manage an installed base of capital assets.

System integration

The core of becoming a solutions provider resides within this capability; organizations need to be able to specify, design and integrate the physical components of a solution with the additional services to offer a complete solution. Davies et al. (2006) explain that organizations currently seek to outsource their production activities to external manufacturers, while retaining their internal capabilities enabling them to lead complex projects and manage large networks. In short, a solution provider, as Davies et al. (2006) argue, is working to creating a system value that is of a higher value to the customer than the sum of the components. An example of system integration is the 3G mobile technology development by Ericsson Inc.: with the development of the 3G mobile phone standard, Ericsson had to integrate the new technology into the existing and operational phone system, while keeping it working with previous generation technology.

A distinction can be made between *single-vendor* and *multivendor* system integrators (Davies et al. 2006). Single-vendor integrators can be defined as organizations, traditionally manufacturing-based, that incorporate internally developed technologies and products into a system. Ericsson Inc., in the aforementioned example, is a single-vendor system integrator as the organization integrated internally developed 3G mobile technology into their existing system. Contrastingly, a *multivendor* system integrator can be defined as an organization, traditionally service-based, that has no in-house technology- or product development and therefore uses products and technologies from (external) leading manufacturers. *Multivendor* system integrators have an advantage as they are able to utilize the best possible products and technologies available to develop the best solution for a customer (Davies et al. 2006). Note, that *multivendor* integrators rely heavily on their supplier network and therefore need exceptional supplier- and network relation capabilities.

Operational service

Solutions providers need to have an exceptional understanding of the needs of their customers to develop and offer a good solution. Not to mention the comprehensive understanding of the solution offered. Operational service capabilities refer to the ability of organizations to provide

services to operate, maintain and upgrade a system during its operational life. Operational services can be defined as intangible (after-sales) services, like maintenance, training, remote diagnostics (in the case of software-based services embedded in a physical product) and fault reporting. Solutions provider are in the perfect capacity to offer these services as they have the best understanding of their offered solution as well as a thorough understanding of their customer (Davies et al. 2006).

An important driver for organizations to develop operational services capabilities resides in the fact that operational services offer several (future) opportunities: 1) a long-term service contract offers a more intimate relationship with a customer and thus the opportunity to signal future needs early, 2) steady revenue streams for the total life cycle of the offered solution, 3) the solution provider is motivated to simplify the maintenance process by designing a system that is more reliable and thus offers more value of the customer, and 4) by providing operational services, the organization is guaranteed of feedback from the operations of their system, which can be implemented into new and improved designs of future products.

Business consulting

Organizations, pursuing a servitization strategy, need to be capable of “providing their customers with advice on how to identify, diagnose and solve operational and strategic problems, develop business plans, exploit the potential of complex new technologies, select and link technology to improve a customer’s business processes and transform a customer’s traditional business model” (Davies et al. 2006); or simply put, business consulting capabilities. Manufacturers traditionally don’t have these capabilities as selling products usually doesn’t include consulting services. These consulting capabilities can be developed by creating joint ventures with service companies, acquiring consultancy companies or developing a consultancy department, and with that consultancy skills, in-house (Davies et al. 2006).

Financing

Another way for organizations to offer more value in their solutions, is by adding financial services. This can take the form of value-sharing contracts that lower the purchase price of a system in return for some of the generated value during its operational cycle, or it can consist out of asset management to reduce the extend and costs of the operating life of the system. In short, organizations pursue some form of subscription/lease business model to decrease initial investments (Davies et al. 2006). According to Davies et al. (2006) a way to achieve this capability without developing these capabilities is forming a strategic partnership. An example of such a partnership is that of WS Atkins with the Royal Bank of Scotland, where Atkins handled design, construction and asset management, and RBS supplied the financing and specific financial services, such as equity savings (Davies et al. 2006).

3.2.2 Identified Capabilities

Besides the four generic capability categories that can be found throughout the literature, more concrete capabilities have been identified in some studies. For instance, the study by Storbacka (2011) identifies sixty four capabilities, categorized within the organizational structure of front-end, back-end and strategic center. Other studies, like that of Ulaga & Reinartz (2011) and that of Brady et al. (2005), have identified capabilities to manufacturers that transition towards solution providers and generic capabilities for solutions providers, respectively. All these studies show the same distinct property: they identify capabilities solutions providers have shown to develop and those capabilities have been categorized across the front-end, back-end and strategic center, or similar organizational structure definitions. While important, these articles lack concrete and practical handles for organizations looking to shift towards being a solution provider.

Solution Business Model framework

Storbacka (2011) has developed a solution business model framework in which sixty-four capabilities and management practices for integrated solutions providers have been identified from a literature review and interviews. A complete list of these capabilities are shown in appendix D. In the collection a distinction has been made between four phases of the solution process: the development of solutions, the creation of demand, the sales of solution and the delivering of the solutions, which are shown in the table as well. Table 2 summarizes and describes the solution phases and capability blocks that solution providers have shown to develop in the front-end and back-end, which Storbacka (2011) has defined as the commercialization and industrialization part of the organization respectively.

Capability block	Developed where in the organization	Description
Develop solutions phase		Phase that aims to combine customer insight with firm's resources and capabilities
Value research	Commercialization / Front-End	Capabilities that ensure in-depth understanding of segments' and customers' business concerns and opportunities
Solutions development	Industrialization / Back-End	Capabilities that enable the development of solution components and configurations that close the gap between value creation opportunities and the extant offerings
Create demand phase		Phase that aims to shape the market to make customer segments aware of the available solutions
Value proposition	Commercialization / Front-End	Capabilities that enable suggestions about how provider's resources and capabilities enable value creation
Solutions availability	Industrialization / Back-End	Capabilities that ensure solutions can be made available and are priced on the value they generate

Sell solutions		Phase that aims at turning identified individual opportunities to orders
Value quantification	Commercialization / Front-End	Capabilities that enable the valuation of the solution to the provider and the customer
Solution configuration	Industrialization / Back-End	Capabilities that enable the creation of solution configurations and support CFU's in creating a tender and pricing of solutions
Deliver solutions		Phase that aims at securing value creation for the customer and value capture for provider
Value verification	Commercialization / Front-End	Capabilities that enable verification and documentation of planned value creation for customer and provider
Solution delivery	Industrialization / Back-End	Capabilities that enable delivery of agreed outcomes in the customers' operations and processes

Table 2: Summary of capability blocks per solution providing phase, based on Storbacka (2011)

Although Storbacka (2011) offers comprehensive insights in the capability that solution providers develop in their organization it ignores the applicability of these findings in an actual organization. This is supported by the fact that Storbacka (2011) hints towards future research opportunities that seek to improve the alignment of the capability blocks that were identified by focusing on a solution business model design that 'fits the firm and its customers'. Simply put, Storbacka (2011) suggests future research should aim at uncovering how these capability blocks can be developed within actual organizations.

Manufacturers' specific advantages in capabilities

Uлага & Reinartz (2011) argue, based on the concept of resource-based view, that firms can achieve competitive advantage by using their capability to deploy their resources for a desired end result. Yet, they apply this reasoning on the transition of manufacturers towards solution providers. More specifically, they argue that manufacturers have certain unique resources that other firms, predominantly service players, lack which they can leverage in the services domain by developing appropriate capabilities. In their paper they argues what unique resources manufacturers may have and, based on these resources, which distinctive capabilities these manufacturers can develop. In figure 4 the results of their research are shown.

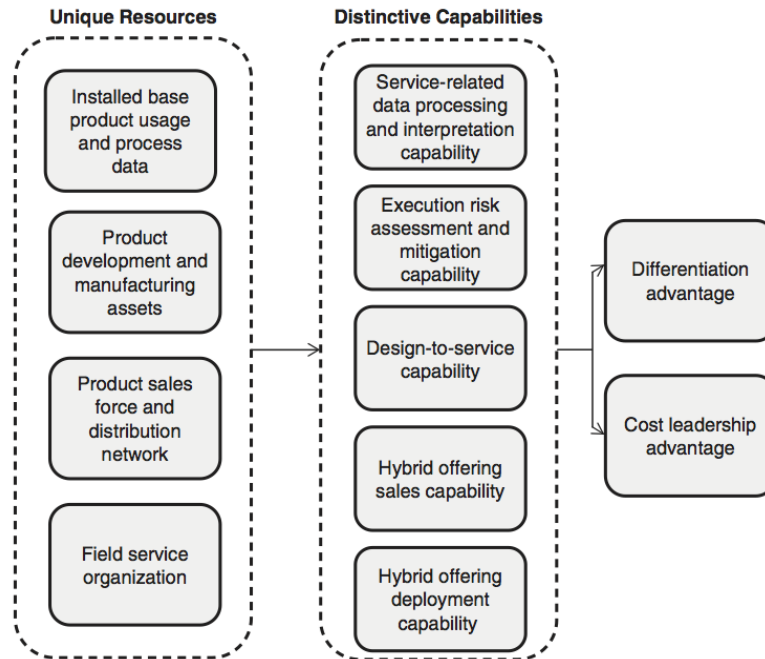


Figure 4: Manufacturer-Specific Resources and Capabilities for Successful Hybrid Offerings, as defined by Ulaga & Reinartz (2011)

As shown in the figure manufacturers have some unique resources that provide an opportunity to gain a competitive advantage when it comes to solutions by developing certain distinctive capabilities. In appendix A a table is included which summarizes the construct definitions and linkages between resources and capabilities, as well as some practical examples of each (Ulaga & Reinartz 2011).

Integrated Solutions Life Cycle

In their paper, Brady et al., (2005) continue on the existing literature by studying the move towards integrated solutions providers. Besides the 4 categories of capabilities (e.g. system integration, operational service, business consulting, and financing capabilities) already described in this paper, they argue that organizations should develop several skills that cover the four phases of the integrated solutions life cycle, as introduced in that same paper.

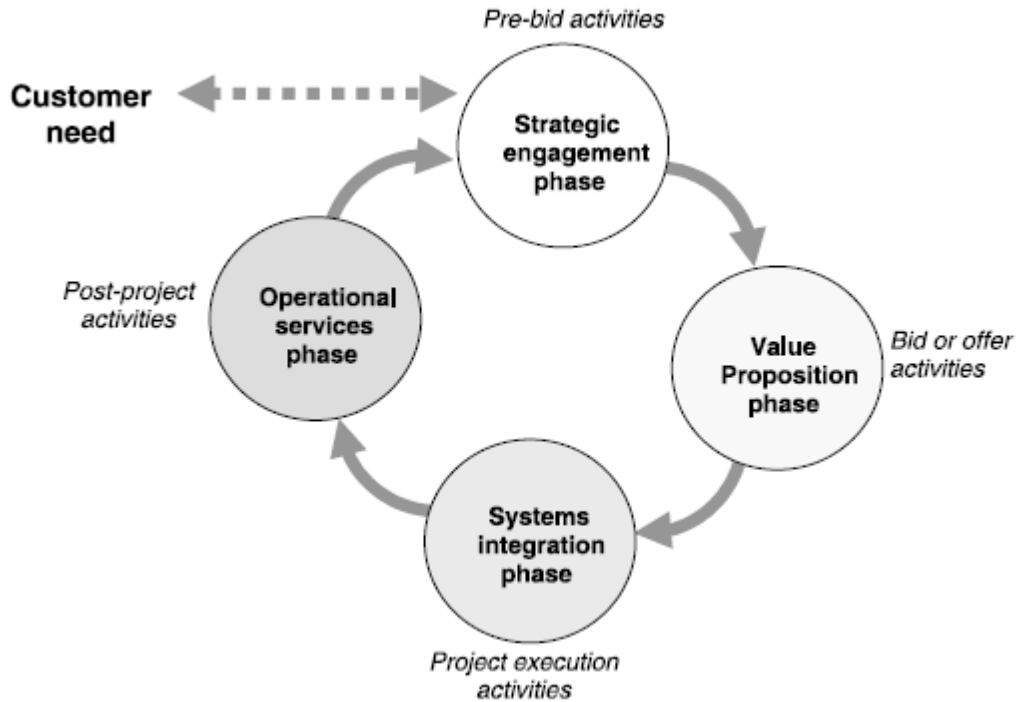


Figure 5: The integrated solutions life cycle (Brady et al. 2005)

They confirm that an organizations' change towards customer-centric thinking has significant impact on what activities need to take place in the project life cycle. The integrated solutions life cycle is shown in figure 5 and illustrates the kind of activities that need to take place (Brady et al. 2005). The capabilities, according to their study, are shown in table 3 with a short description, and, if mentioned in their paper, an example of how that skill would translate within the organization (Brady et al. 2005).

Capability	Description	Concrete example
Key account management	Knowledge of customers' markets, business processes and their own customers in particular market segments.	People capable of becoming embedded within the customers' businesses over a long period of time.
Risk analysis and management	Deployment of new skills in identifying, evaluating and managing risk, including real options theory.	Management of risk registers and ability to understand long-term risks in supply streams.
Financial acumen	New skills in understanding base case financial models, whole life costing, capital expenditure and operational expenditure.	
Legal Skills	New capabilities in long-term contracting framework agreements, concession-building, joint venturing,	

	risk mitigation, and intellectual property.	
Information management	Skills needed to manage information over very long timescales and across different vintages of technology.	
Innovation management	Ability to assess dynamics upstream and downstream over long term.	Appreciation of incremental innovation to extract more from assets in-use as well as radical innovation. Including the ability to spot when new value can be added during a facility's life because of technical change.
Portfolio management	Skills in building teams and consortia, assembling and managing concession partners, etc.	

Table 3: Skills that are developed within solution providers, covering the four phases of the Integrated Solution life cycle (Brady et al. 2005).

3.3 Developing capabilities

Restructuring an organization in terms of reconfiguring its capabilities and developing new competences is challenging (Ceci & Masini 2011). In short, organizations that traditionally offer goods must integrate their manufacturing-oriented competences with more service-oriented capabilities. Yet, services require different organizational principles and structures from what a manufacturer is accustomed to (Ceci & Masini 2011). Hence, challenges arise because of the tension between preserving the organizations' strengths and developing new capabilities (Storbacka 2011; Galbraith 2002; Brady et al. 2005).

3.3.1 Front-end vs. Back-end

As is shown in figure 3 by Davies et al. (2006) and discussed by others (Foote et al. 2001; Galbraith 2002; Storbacka 2011; Pawar et al. 2009), a clear distinction is made between the Front-end and the Back-end within a solution providers' organizational structure. This is done by organizations to build themselves around their customers' current and future needs. As mentioned earlier, the main function of the Front-end of an organization is customer interaction, market signaling and solution implementation, while the Back-end is mainly responsible for developing solutions, develop a portfolio with products and services, and create standardized solution 'platforms' to support the Front-end in creating easily customizable solutions (Davies et al. 2006; Foote et al. 2001). As discussed in the previous section, studies have identified which specific capabilities an organization should develop, in both the front- and back-end (Brady et al. 2005; Davies et al. 2006; Storbacka 2011).

Front-end

When zooming in on the front-end of the organization, Davies et al., (2006) and Foote et al., (2001) discuss the specific requirements and the tasks performed by the Front-End. More

specifically, the front-end consists of so-called Customer Facing Units (or CFU's) which main function exists to manage strategic engagements with the customer, develop value propositions, integrate systems and provide operational services. They argue that these CFU's must consist of multiskilled and cross-functional people, mainly experienced in financing, managing key accounts, legal and technical design.

But, arguably the most important function of the front-end is that of identifying solutions that could possibly be redeployed to other customers. More specifically, the front-end must be able to distinguish between 'one-of-a-kind' and 'first-of-a-kind' solutions, solutions that are specifically for a single customer and solutions that offer opportunities for other customers respectively, so that the back-end can develop standardized components for a first-of-a-kind solution instead of wasting effort and manpower on one-of-a-kind solutions. Consequently, there a continuous struggle between the front-end and the back-end as the front-end seeks to deliver customized solutions, while the back-end seeks to standardize (part of) the solutions to decrease customization- and implementation time and costs. According to Davies et al., (2006) Ericsson estimates that 'only' 25% of customization is needed in the front-end since the other 75% can be taken compiled from off-the-shelf reusable modules. Organizations relying on standardized business processes, pricing and guarantees for service reliability, revise their service portfolio constantly to improve the process of selling and delivering solutions by their front-end.

The front-end also needs certain capabilities in a solutions provider; for instance, Payne, Storbacka, & Frow (2008) describe in their paper several abilities solutions providers must develop: the ability to understand the customers' value creating processes, the ability to create solutions that enable improved value creation for the customers, the ability to create demand for these solutions, and the ability to sell the solutions to the individual customers and receive compensation based on the customer's value-in-use. These capabilities can be found in other studies as well (Davies et al. 2006; Storbacka 2011). More specifically, it is possible to consolidate all capabilities, mentioned in the literature as front-end capabilities, as is shown in table 4.

	Develop Solutions	Create Demand	Sell Solutions	Deliver Solutions
Storbacka (2011)	<i>Value research:</i> <ul style="list-style-type: none"> • Ability to proactively sense barely explicit customer needs • Ability to generate customer intelligence • Ability to initiate innovation together with customers • Ability to quantify customer value • Ability to involve lead customers in development • Ability to develop contract models for lead customer involvement 	<i>Value proposition:</i> <ul style="list-style-type: none"> • Ability to define segment specific value propositions • Ability to work proactively with value propositions • Ability to communicate the offerings to the market • Ability to combine campaign plans with product, marketing and sales management 	<i>Value quantification:</i> <ul style="list-style-type: none"> • Ability to make customer specific value propositions • Ability to configure customer specific solutions • Ability to 'provoke' customers' decision makers in dialogue • Ability to illustrate value of the solution • Ability to unify tools for quantifying customer value • Ability to identify and factor risks in pricing 	<i>Value verification:</i> <ul style="list-style-type: none"> • Ability to secure accurate input in order-delivery process • Ability to handover contracts between departments • Ability to regularly verify created value • Ability to measure customer profitability • Ability to collect and share benchmark data throughout the firm • Ability to document solutions for redeployment
(Brady et al. 2005)		Key account management		Information management
(Davies et al. 2006)		Business consultancy capabilities		Operational service capabilities
(Uлага & Reinartz 2011)			Hybrid offering sales capability	<ul style="list-style-type: none"> • Service-related data processing and interpretation capability • Hybrid offering deployment capability

Table 4: Consolidation table showing all capabilities solution providers have shown to develop in the front-end, categorized by each solution phase described by Storbacka (2011)

The capabilities in the table show some overlap, or a similar focus. Hence, a number of capability dimensions can be interpreted, described in table 5.



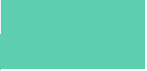

Capability Dimension	Description	Color in Table 4
<i>Customization capabilities</i>	Capabilities that enable the customization of a solution to customers' specific needs and showing that to the customer	
<i>Market- understanding and interaction capabilities</i>	Capabilities that enable an in-depth understanding of the market and its' implicit needs, and enables market interaction both in the co-development as in the value propositions	
<i>Information management and communication capabilities</i>	Capabilities that enable efficient internal communications, knowledge exchange and cross-departmental cooperation	
<i>Sales and service delivery capabilities</i>	Capabilities that enable account management, a solution sales-force, and effective delivery of solutions, both in terms of monitoring as after-sales services.	

Table 5: Capability dimensions, interpreted from identified capabilities shown in TABLE 4

Back-end

The back-end can be best described as the supplier of the core product- and/or service components of a solution (Davies et al. 2006). More specifically, the units that comprise the back-end should provide so-called "solution-ready" products and services that can be combined in various ways, a process of "mix and match", into a customized offering for customers (Davies et al. 2006; Storbacka 2011). To this end, the back-end should consist of staff with specialized expertise in areas such as product development, marketing, communications, human resources, professional services and systems integration.

Davies et al. (2006) argue that "repeatability is the measure of a company's progress in providing integrated solutions". The main factor in supporting repeatability is the design of business processes that have enough elements of uniformity to justify developing a general and 'averaged' process (Baines et al. 2009; Storbacka 2011). The experiences from customer specific solution projects need to be codified in manuals and processes so they can be reused in subsequent situations (Storbacka 2011; Acha et al. 2005). Moreover, other studies suggest that product platforms should be developed with modular components, albeit products or services (Davies et al. 2006; Booz-Allen & Hamilton 1999; Oliva & Kallenberg 2003). More specifically, the back-end should strive to develop standardized solution platforms that can be customized by the front-end based on customers' needs (Storbacka 2011; Windahl et al. 2004). In short, the main development of solutions is performed by the back-end of organizations, while the front-end seeks to improve the value and sell the solutions.

Consequently, the capabilities solution providers have shown to develop in the back-end focus on this function: the configuration and standardization of solution components. A similar consolidation table, of in the literature identified capabilities in the front-end, can be made for capabilities developed in the back-end. Using the same categorization as in the previous table, the four phases of Storbacka (2011), table 6 shows all capabilities identified in the literature as being developed in the back-end.

	Develop Solutions	Create Demand	Sell Solutions	Deliver Solutions
Storbacka (2011)	<i>Solutions development:</i> <ul style="list-style-type: none"> Ability to let customer insight drive the development process Ability to close the gap between needs and offering Ability to build standardized components to be used in solutions Ability to digitize and code solution components Ability to regulate solutions configuration 	<i>Solutions availability:</i> <ul style="list-style-type: none"> Ability to predefine solution configurations Ability to translate earlier solutions to configurations Ability to price solutions on value to customers Ability to translate performance level of solutions within customers into pricing categorization Ability to communicate with front-end regarding the available solutions 	<i>Solution configuration:</i> <ul style="list-style-type: none"> Ability to use configurations for customer solutions Ability to develop contract models which support value based pricing Ability to develop new systematic pricing discipline Ability to analyze business cases Ability to develop standardized tenders Ability to provide costing data for solutions to front-end 	<i>Solution delivery:</i> <ul style="list-style-type: none"> Communication capabilities, both internal and external Ability to monitor and correct delivery problems Ability to manage supplier/partner network Ability to develop and secure long-term post-deployment cooperation.
(Brady et al. 2005)	Innovation management capabilities	Risk analysis and management		Legal capabilities
(Davies et al. 2006)	System integration capabilities		Operational Service capabilities Financing capabilities	
(Ulag & Reinartz 2011)	Design-to-service capability		Execution risk assessment and mitigation capability	Hybrid offering deployment capability

Table 6: Consolidation table showing all capabilities solution providers have shown to develop in the back-end, categorized by each solution phase described by Storbacka (2011)

As with the capabilities from the front-end, overlap and similarities in focus can be found with the capabilities in the back-end. Consequently, based on the above capabilities, dimensions can be interpreted and described as is shown in table 7.

Capability Dimension	Description	Color in Table 6
<i>Solution configuration and standardization Capabilities</i>	Capabilities that enable the development of solution configurations (i.e. platforms), standardized components and codification of both the configurations as the components	
<i>Customer insight and deployment capabilities</i>	Capabilities that enable the use and development of customer insight and interaction in the solution development and deployment process	
<i>Pricing and risk assessment capabilities</i>	Capabilities that enable in-depth understanding of the solution value for the customer and translate this into pricing categories, component costing data and risks for the organization	
<i>Communication capabilities</i>	Capabilities that enable effective communication internally, with the front-end regarding supply and development of solutions, and externally, with suppliers and partners regarding development opportunities	

Table 7: Capability dimensions, interpreted from identified capabilities shown in TABLE 6

3.3.2 R&D within Solution Providers

Solution providers organize their solution activities as projects, as they need to be flexible and customize solutions to customers' specific needs (Storbacka 2011; Davies et al. 2006). In their study Acha, Gann & Salter (2005) conclude that the central R&D unit, which traditional manufacturers still employ, is ineffective in project-based environment. This conclusion can also be drawn for solution providers, as Storbacka (2011) argues that one of the main capabilities the back-end should have is the ability to codify experiences from customer-specific solution projects into manuals and business processes so that they can be reused in subsequent situations. Brady & Davies (2004) provide a similar insight as they argue that providers can build new capabilities by learning from project to project, and 'from project to organization'. Continuing on these perspectives, viewing capabilities within solution providers as situated within the back-end, the front-end or the strategic center seems warranted and sufficient.

With regards to solution providers, the literature prefers using terms as multifunctional teams and people with certain skills/knowledge instead of "marketing- or R&D-department" (Isaksson et al. 2009; Davies et al. 2006; Shepherd & Ahmed 2000; Storbacka 2011). Important to remember with these studies is that they incorporate a solution providers' perspective. More specifically, they study 'completed' or mature solution providers; organizations that have fully adopted a solution strategy. Consequently, the literature offers little support for organizations looking to transition towards solutions; no knowledge has been developed to better understand where all capabilities have been developed, in what department. Organizations that seek to offer solutions follow certain steps of maturity. Consequently, it can be argued that when organizations first start offering solutions they have yet to reorganize (i.e. their structure and/or culture remains rather unchanged). Therefore, using a departmental perspective (i.e. a perspective that focuses on the traditional structure of organizations) seems warranted as it strongly corresponds with the structure of organizations embarking on their journey to becoming solutions providers.

Zooming in on the R&D department, as stated earlier, since a solution provider is organized on a project basis, there is no central R&D department in a "mature solution provider" (Acha et al. 2005; Storbacka 2011; Brady & Davies 2004; Biggemann et al. 2013; Davies et al. 2006). Though, the development of solutions, and its components, is a function of the back-end, arguably similar to the function of the "traditional" R&D department, which is developing products. Consequently, it is safe to assume that (some) of the capabilities from the literature, identified as being developed in the back-end of solution providers, have been developed in their (former) R&D department. Yet, many studies also argue the increasing importance of customer interaction in solution development when becoming a solution

provider (Biggemann et al. 2013; Ettlie & Rosenthal 2011; Davies et al. 2006; Storbacka 2011; Baines et al. 2009; Windahl & Lakemond 2006). Continuing in this direction, studies suggest that the traditional culture of technology “push” by R&D departments is replaced by a development process “more in touch with the market- and customer needs” (Shepherd & Ahmed 2000; Matthyssens & Vandenbempt 2008; Davies et al. 2001; Galbraith 2002). Thus, the development process, a function of the traditional R&D department, is moving more toward the front-end of the organization. Consequently, some capabilities identified in the literature as being developed in the front-end of solution providers may arguable be found to be developed in the (former) R&D department.

Having said all that, it is important to realize that these are mere suggestions for future research avenues made in the literature, not specifically studied and scientifically based statements. More specifically, the literature remains rather vague when it comes to organizational structure of solution providers, besides what has been described in previous sections of this paper, or when it comes to capability development, besides the general capability studies that have been described in previous sections. This is surprising, considering multiple studies have dedicated their research to better understand how solutions are developed; what challenges may arise and what the requirements are for good solution development (Isaksson et al. 2009; Windahl & Lakemond 2006; Miller et al. 2002; Brady et al. 2005; Davies et al. 2001). To go even further, Eggert et al. (2011) argues that firms with high product innovation activities experience more organizational conflicts due to the additional requirements of their resources and capabilities, which have proved successful in the past. But again, no concrete studies have been done to offer a better understanding on how organizations can best face these conflicts, or how to align with all requirements. More importantly, the literature offers no insight in what these requirements are specifically. The literature offers merely broad descriptions of factors and requirements, or specific information regarding capabilities but from an organization-wide perspective.

What this means for the R&D department within solution providers seems simple: to assess what capabilities and requirements are needed for solution development and then develop them. Yet, this exact piece of information is missing in the literature. To better underpin the importance of R&D, or innovative activities within solution providers, are the statements by Selden & Macmillan (2006): *“By looking closely at customer profitability; segmenting customers according to their needs and desires; creating and delivering a superior customer experience; organizing around the customer; and putting customer-facing people in charge, firms achieve a holistic customer-centric innovation system. [...] Firms that practice customer-centric innovation [...] create a truly virtuous learning cycle and a never-ending source of competitive advantage.”* Simply put, although the entire organization will shift when becoming a solution provider, the

engine behind offering customer-centric innovation and solution development, the R&D department or teams, remains barely studied.

4. Research aim

Summarizing, it can be concluded that solution providers are organized on a project basis (Storbacka 2011), there is some understanding of the responsibilities and capabilities performed by the back-end and the front-end (Storbacka 2011; Brady et al. 2005), part of these responsibilities and capabilities are closely related to those of the “traditional” R&D departments (Storbacka 2011; Acha et al. 2005; Shepherd & Ahmed 2000), but there is no clear understanding of what capabilities are developed in what specific department, or part within the organization (Storbacka 2011). More importantly, previous studies have only used an organization-wide scope, which could imply they might have missed some specific capabilities developed within a certain department, in this case the (former) R&D department.

Continuing on this conclusion a conceptual model (Figure 6) is developed that shows this lack in literature, which is the focus of this paper. This conceptual model is based on the organizational structure solutions providers have adopted (Davies et al. 2006; Foote et al. 2001) combined with the specific capabilities that have been identified in the literature as being developed in the back-end and the front-end, shown in table 6 and 4 respectively (Storbacka 2011; Brady et al. 2005; Davies et al. 2006; Ulaga & Reinartz 2011). The conceptual model mentions the capability dimensions that were interpreted from the identified capabilities in the literature, shown in table 5 and 7.

What becomes apparent from the capability dimensions in the conceptual model, the back-end does not focus purely on the development of solutions; the back-end also performs other functions within the organization. Which of these capability dimensions ultimately are developed within the (former) R&D departments will be concluded from this research as well. Furthermore, since the scope of this research is more narrow, focusing solely on the R&D department, than that of previous studies, focusing on organization-wide capability research, it can be argued that yet unidentified capabilities developed in the R&D department might be identified; 1) capabilities might have been overlooked from an organization-wide perspective, or 2) capabilities that have been identified as part of the front-end that are developed within the R&D department to close the gap between the market and solution development.

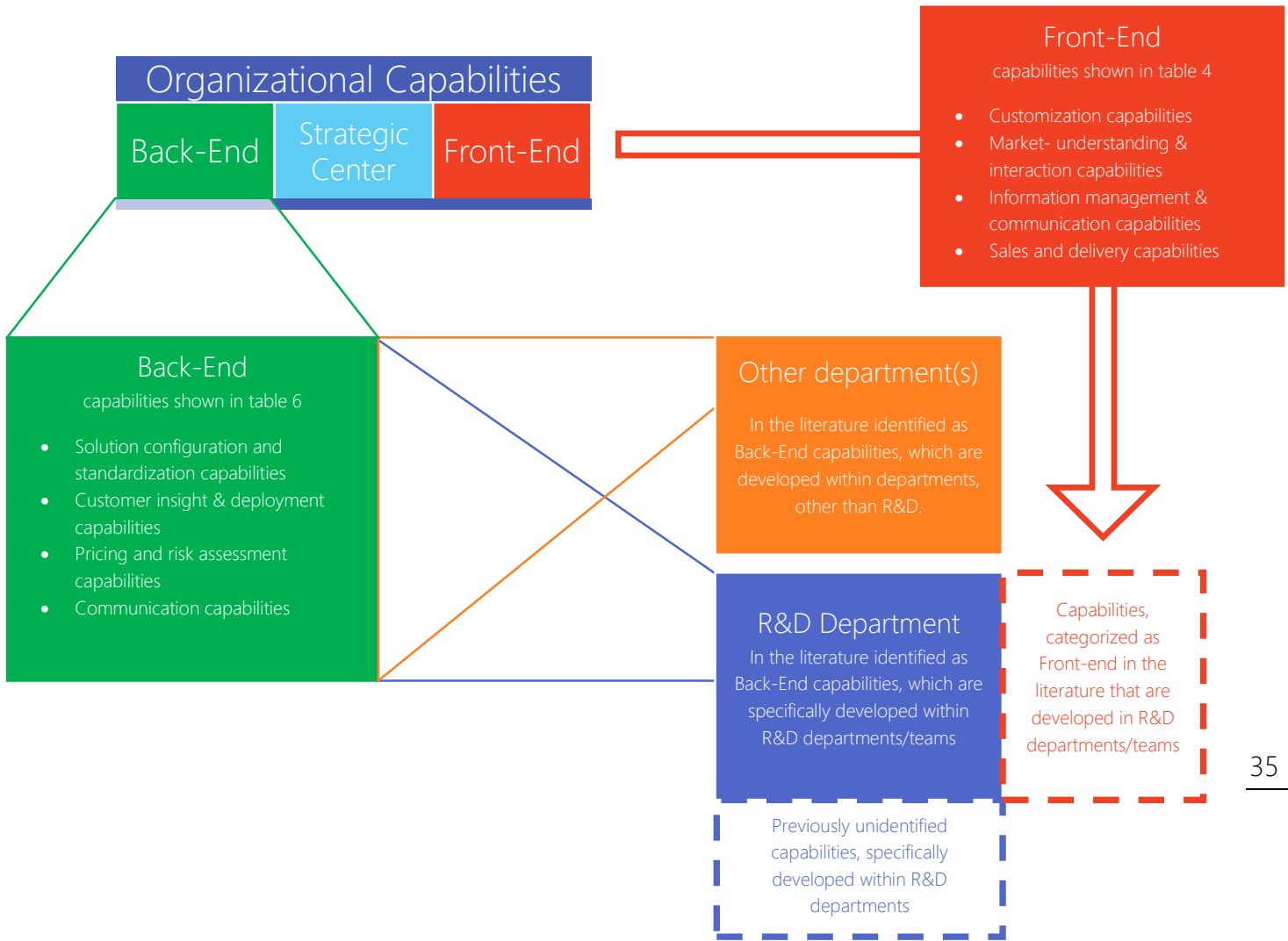


Figure 6: Conceptual model used for this research process. The distinction in the literature, regarding organizational capabilities, is shown combined with the capability dimensions interpreted from the literature.

In short, this research will focus on identifying which capabilities are developed within teams undertaking the innovative activities within the organization, usually categorized as the R&D department of an organization, to successfully develop product-service combinations. This research is formulated in the following question:

"What capability dimensions are developed within the R&D department, or within the teams that undertake the innovative activities within the firm, of solution providers, to successfully develop integrated solutions?"

5. Research process

In the context of the servitization literature this research paper explores what capabilities are developed within R&D departments of organizations attempting to become, or have already completed the transition to, a solution provider. The research was carried out between April and July 2014, and involved a group of eight multinational corporations from different industries, from which 9 interviewees were selected, and one expert in the field of solutions, consulting several multinational manufacturing organizations in how to transition towards solutions. These participating firms already sell solutions, besides (or instead of) pure goods or services, and/or are interested in exploring the opportunities in the transformation from product to solutions.

The research process consisted of two phases: (1) framework development and (2) explication of capabilities. In the first phase a wide selection of development, sales, operation management and capability literature focused on solutions and related areas were reviewed. From this literature review a framework was developed enveloping all (currently) identified capabilities that solution providers have developed in the back-end and the front-end, shown in table 4 and 6. The second phase consisted of expert interviews, with senior managers overseeing the transition towards solutions, or senior managers currently active in developing and implementing solutions. These managers were contacted through an earlier Company X panel and cold calling. The expert on solutions, currently working in a consultancy organization specialized in solutions, was contacted through a training program the organization was providing Company X.

5.1 Interviews

Arguably, when checking what capabilities, already identified by the literature, are present within R&D departments of solution providers, quantitative verification would be sufficient. However, the smaller and more specific scope of this research paper, compared to that of previous studies on identifying capabilities within solution providers (Storbacka 2011; Brady et al. 2005; Davies et al. 2006), may prove useful for identifying yet unidentified capabilities. Consequently, a more exploratory research process is needed; hence the choice for semi-structured interviews. By using semi-structured interviews, this paper is able to check qualitatively the development of specific capabilities within R&D departments, or teams, while simultaneously remain open to possibly identify *new* capabilities.

The interviews are the main source of identifying the capability dimensions and specific capabilities that are developed within the research departments. As the aim of this research paper is to explore and check what capabilities are developed within R&D of solution provider, the interviews were semi-structured. The interview protocol, showing the interview structure

and questions is shown in appendix C. Note that the interviews were part of the data collection for two research papers, consequently the interviews discussed subjects that were not the focus of this paper. Simply put, the questions focused on another research paper were omitted from the interview protocol, as shown in appendix C. Consequently the protocol *only* presents the questions relevant to this research paper.

Interview guide

In the first part of the interview (questions A through D), respondents were asked to describe their core business and market environment and the introduction of solutions within the firm and how they organized to develop and offer these solutions. In the second part, respondents were asked to provide an example of a recent solution that has been developed and describe the details surrounding this solution (questions 1 and 2). Question 3 aims to test the interviewee's knowledge and understanding about capability development within his/her firm. Once the understanding of capabilities is confirmed, question 4 will explicitly probe which capability dimensions can be found within the R&D department, or teams undertaking the innovative activity, within the interviewees' firm. Each capability dimension will be described, according to the description in the interview protocol, before the interviewee is asked whether this dimension is (to some extent) developed within their R&D department. To prevent priming with the interviewee, a maximum of 1 example capability per dimension from tables 4 and 6 are given. The interview finishes with question 5 aimed at identifying any other, yet unmentioned, capabilities the interviewee feels have been developed.

Sample

The interviewees were selected on a number of criteria:

- The interviewee works at a large multinational firm, as literature suggests larger firms have more financial strengths to successfully transition into solutions.
- The firm of the interviewee currently offers some sort of solution (or product-service combination)
- The interviewee works, or has recently worked, in a research capacity, and has in-depth knowledge of how solutions are developed within his/her firm.
- The aim is to select interviewees from organizations in different sectors, to get a more general perspective.

The key sample characteristics in table 8 show that the respondents represent industrial companies operating in various product-, and in some cases services-, markets. The interviewed managers from each organization are key decision makers with regards to development/R&D projects, new service and solution development, or strategy.

Interviewee	Participant Background	Company Size	Sector
1	Expert Interview – Managing Consultant specialized in solutions	N/A	Consultancy
2	Vice-president business development	Revenue: €1.3 billion Employees: 6.100	Infrastructure & Rail
3	Service business development manager	Revenue: €5 billion Employees: 12.000	Automotive & transport
4	Program manager, service development	Revenue: €39.3 billion Employees: 150.000	Electrical Equipment
5	Head of New Business Development	Revenue: €74 billion Employees: 112.206	Chemicals
6	Senior design engineer, service business	Revenue: €39.3 billion Employees: 150.000	Electrical Equipment
7	Senior manager technology operations	Revenue: €741 million Employees: 3.000	Logistics
8	Marketing & Design Director, services	Revenue: €213 million Employees: 1.200	Office equipment
9	Head of R&D / Strategy manager	Revenue: €2.860 billion Employees: 20,710	Printers & Copiers
10	Service Innovation Manager	Revenue: €24.26 billion Employees 80.534	Steel

Table 8: Qualitative Study Sample

5.2 Analysis and Interpretation

The interviews lasted, on average, forty-five to seventy minutes and have been conducted either face-to-face or by telephone. The interviews, nine out of ten, have been recorded and transcribed verbatim. The transcriptions of the interviews were then coded using a topic coding method. The topics used for coding were meant to identify specific capabilities within the capability dimensions from tables 5 and 7. The exact codes, their overlaying theme and related capability dimensions are presented in table 9 for clarification.

Codes	Theme	Capability Dimension
<ul style="list-style-type: none"> • Customized solutions • Single customer • Customization • Specific needs 	Customization	Customization Capabilities (FE)
<ul style="list-style-type: none"> • Needs identification • Market analysis 	Market understanding	Market- understanding and interaction capabilities (FE)

<ul style="list-style-type: none"> • Market needs • Market opportunities • Market understanding 		
<ul style="list-style-type: none"> • Co-development • Co-creation • Key account management • Customer communication • Customer interaction • Customer involvement 	Customer Interaction	Market- understanding and interaction capabilities (FE)
		Customer insight and deployment capabilities (BE)
<ul style="list-style-type: none"> • Market data • Departmental cooperation • Benchmark data • Solution documentation 	Information Management	Information management and communication capabilities (FE)
<ul style="list-style-type: none"> • Cross-departmental communication • Sales, Marketing and R&D communication 	Internal Communication	Information management and communication capabilities (FE)
<ul style="list-style-type: none"> • Sales force • Product sales • Selling solutions 	Sales	Sales and service delivery capabilities (FE)
<ul style="list-style-type: none"> • Solution delivery • Maintenance • Services department • Services 	Service delivery	
<ul style="list-style-type: none"> • Scalable • Standardized components • First-of-a-kind • Standard configuration 	Standardization	Solution configuration and standardization capabilities (BE)
<ul style="list-style-type: none"> • Price of solution • Pricing Disciplines • Pricing Models • Customer value 	Pricing	Pricing and risk assessment capabilities (BE)
<ul style="list-style-type: none"> • Network • Partnerships • Alliances • Suppliers • Knowledge exchange 	External Communication	Communication capabilities (BE)
<ul style="list-style-type: none"> • Application domain • Domain understanding • Networking • Knowledge creation 	Unmentioned capabilities	N/A

Table 9: Presentation of all codes used for coding the interviews, their overlaying themes and their related capability dimensions (FE and BE stand for Front-End and Back-End respectively).

After coding, the codified excerpts will be categorized with their specific capability dimension. The excerpts of each specific dimension together will be graded to what extent that dimension has been developed in the R&D department, or teams, using a five point scale, consisting of: "to no extent", "to some extent", "to a medium extent", "to a large extent" and "completely". The grading will be based on the relative number of capabilities an interviewee has mentioned that were developed within their R&D department to the relative number of capabilities within that dimension that were not developed in the R&D department. Alternatively, if the interviewee was able to provide his or her own estimation to what extent that specific capability dimension was developed in the R&D department, this grading would be the predominate.

The open question at the end of the interview, meant to see whether the interviewees think other capabilities than those in the dimensions have also been developed in the R&D department, or teams, is coded using the overarching theme, unmentioned capabilities (as can be seen in table 9). The coded excerpts that are not closely enough related to the capabilities identified by the literature are then categorized within a certain dimension that fits best, based on the dimension and capability description. And finally, grading will be revisited to include the newly identified capabilities.

6. Findings

The findings are presented in the following way. First, a within case analysis is presented of each of the interviewed firms to provide more in-depth information of the cases, used in the across case analysis in sections 6.2 and 6.3. Then, in section 6.2 each capability dimension, both from the front-end (table 4) and the back-end (table 6), will be separately discussed with excerpts from the interviews, conveniently placed at the end of that particular subsection, concluding with a statement to what degree that specific dimension is developed within R&D departments. Afterwards, the capability that hasn't explicitly been mentioned in the literature, but was described in the interviews will be explicated. The findings section will conclude with a table summarizing all discussed findings.

6.1 Case analysis

In this section the within case analysis results are presented by a short summary of each interviewed case. Note that interviewee 4 and 6 are from the same company and are thus combined in one case summary.

Case 1

Not applicable; The interviewee is deeply involved in change processes of manufacturing companies as a consultant. He has more than 20 years of experience in development of service offerings in manufacturing firm, guiding this process, amongst others, at IBM and Océ when he was employed there. Currently he is hired to help Company X in the development of service offerings.

Case 2

The second company that was interviewed was a multinational active in the rail infrastructure industry, amongst others. The company revenue is €1.3 billion and has 6.100 employees. The origin of the company is in rail and has developed specialization in civil infrastructure and buildings and technology. Major customers are companies that own the tracks but also mining companies and governments. Their latest solution to hit the market is a diagnostic system that increases uptime of tracks for their owners. They have some solutions on the market but are experimenting with different propositions as well. Using Davies's stage classification (figure 3) the company can be classified in the second stage as it is moderating current units and setting up new ones to accommodate the increase for demand of solutions and development of current ones and future offerings. The strategy of the firm is to offer highly customized solutions, specifically designed for every individual customer and little standardization of solutions. The company is market-driven, i.e. looks for needs in the market, but relies on in-house R&D for technological breakthroughs and opportunities or future offerings. R&D is not centralized into one unit. Rather, knowledge is valorized in different, dedicated sub-units with

R&D teams to capitalize on their expertise in knowledge of specific areas, following the ideas of Shepherd and Ahmed (2000). A new unit is created to govern the processes and acts as a hub to link technological possibilities from the different sub-departments with customer needs, much like the strong centre Foote *et al.* (2001) and Davies *et al.* (2006) advocate. Both product components as service components are developed in these departments by the teams.

Case 3

The third company is a multinational active in 28 countries and their main market is automotive, marine, transport and power generation. The company grew from a small car manufacturer into a global dealer of all sorts of vehicles, both for consumers and business, having a revenue of € 5.0 billion and 12.000 employees. The offerings of the company are mainly maintenance and guaranteed increased uptime of vehicles and financial services such as flexible payments. They are currently working on extending such services to vehicles from competitors and used cars, increasing their customer base. The company has readily changed from a product-based company into a service-based company as the main source of income are the value-added services that are sold through the vehicles. Consequently the company is in the third phase of Davies's classification as the organization is structured to sell the solutions with front-end units, back-end units and strong centres and it is adopted throughout the entire organization. The company has decided to develop their services in-house and structured service development teams in the back-end, yet has the technology outsourced to partners. As a result the company is fully focused on their customers and not technology-driven but market-driven. As such, the activities consists mainly of developing the services needed for customers and integrating it with the products they buy from their partners. This is done by various teams that are each allocated to specific key accounts and customer segments per industry.

Case 4 & 6

This company is a global player in utility, industry systems, electronics and robotics. With a revenue of €39 billion and 150.000 employees, the company's solutions business is going well. The company sells complex systems in these various industries and offers a range of services from guaranteed extended uptime to complete asset management for clients. The company is used as a good example of a solutions provider because of their success and the company has been part of case studies, for example in Davies's research (2006). Although the company is designing customized solutions for their customers, the company still has a strong technology push and still relies heavily on R&D activities for superior products and in the end the best solutions. The development of the solutions starts with product development and later on, dedicated service development teams design the total offering for customers.

Case 5

Company five is a multinational in the chemical industries. It has a revenue of € 74 billion and has 112.000 people employed. The company has a full range of offerings for their clients, from simple stand-alone products to complex combinations of different products and added services such as offering training programs to handle the products and help create formulations for specific product needs. The sales of products are still more important for the company than solutions and the company is still looking at how to create more value with services by looking at new markets to explore and better understand their customers. They are doing so by restructuring some of the business units that sell related products into new operating divisions that offer a total package of products and tailor the offerings with customer specific service offerings.

Case 7

This multinational is the number one supplier of automatic baggage-processing equipment and related services. The main solution offered by this multinational is an integrated logistical system for automating warehouses and distribution hubs combined with services to enable efficient use of the machinery, as well as maintenance services. This organization is very customer-focused, using customer insights and market needs, through consulting services and interaction, to develop new solutions. This organization has no silo structure, but a 'pool' of employees which can be put to use within certain projects. Consequently their R&D department is not centralized; solutions are developed by project-teams, active at the customer, which are then, after successful implementation, made modular to enable redeployment.

Case 8

This multinational has been active in the domain of office supplies and office facility management for more than a century. Recently the company has shifted its focus from mainly producing office supplies to mainly offering services related to office facility management; these services can best be described as in-house decorating, maintenance and facility management. The main solution offered by this firm is the combination of internally manufactured and designed office supplies together with a consultancy service, aimed at identifying a customers' needs with regards to office interior. In terms of restructuring, this multinational still uses the traditional structure, from before the introduction of solutions, but has improved the communication between departments drastically.

Case 9

This multinational corporation is one of the world's leading firms in the document- and information-management industry. However, their focus has shifted in the last few years to a more business-processes focused approach. So, instead of offering solely document or information automation equipment, they have expanded their offerings to incorporate

improving the entire business process surrounding information-management. Ultimately their services have become the main offering, expanded with products. They restructured their R&D department slightly by moving their development more towards the customer-facing units, letting business units develop their own solutions and services. There is some overarching entity, but the main R&D is decentralized and scattered throughout the BU's.

Case 10

This multinational is active in the steel industry and is one of the larger corporations in this sector. They are quite new to added value services, in terms of product-service combination propositions. Consequently, they are quite new to solutions but they are attempting to offer solutions. One of their main solution is offering a solution that increases the delivery certainty (which is currently 70%). Their R&D development is departmentalized and focused on improving their own business- and production processes.

6.2 Front-end Capability Dimensions

The following section discusses the findings from the interviews, specifically regarding the capabilities that the literature has defined as front-end capabilities. The capability dimensions and specific capabilities are shown in tables 4 and 5.

Customization

The customization capability dimension can be described as enveloping capabilities that enable the customization of a solution to customers' specific needs and showing that to the customer. Among the interviewees this dimension was well understood and *all* interviewees claimed to have developed these capabilities, as shown by their statements in quote box 1. But, the interviewees were also unanimous that these capabilities were only developed in front-end departments, mainly categorized as their sales- and/or account management teams. Thus, this capability dimension is *to no extend* developed in the R&D department.

This is not surprising, as the literature also shows the debate between standardization vs. customization, arguing the development teams focus on standardization. Consequently, as R&D departments, or teams, are responsible for the development, the assessment that customization capabilities aren't found there seems logical. One interviewee even went as far to state that his organization focuses *purely* on providing customized solutions to their customers, disregarding all standardization possibilities and benefits mentioned in the literature. But again, this interviewee stated that the customization was done by the department that was interacting with the customer, and not their R&D related teams.

Quote Box 1 *Customization capabilities*

Interviewee 2

"We focus mainly on one single customer [...] but we try to export our knowledge to other countries/customers. We can provide each customer with their exact requirements, thus we focus on customized solutions. Customer demands are very diverged, thus require custom made offerings. [...] Currently this strategy remains profitable, hence we employ standardization next to never."

Interviewee 9

"We are currently transforming our local offices to provide scalable customized solutions. Providing solutions that are both customized for each customer but also scalable to many customers is a crucial challenge in this process. [...] The customization of the offerings is done by our [local] customer facing business units."

Market- understanding & interaction

The market- understanding & interaction capability dimension can be described as enveloping capabilities that enable an in-depth understanding of the market and its' implicit needs, and enables market interaction both in the co-development as in the communication of value propositions. Regarding this subject interviewees diverged with regards to the exact capabilities that are included in this dimension. All interviewees agreed, some in more words than others, that a thorough understanding of the market needs and extensive interaction with customers is of significant importance when providing solutions.

As interviewee 5 stated, his organization is actively working on obtaining extensive market understanding. Looking at his quote, both the operational/local units, defined as the front-end, and the technical people, which during the interview is how he described R&D related teams, are tasked with understanding the market. Indicating that R&D teams in his organization have developed capabilities to enable them to actively engage in market sensing.

As one interviewee (interviewee 2) noted the communication of value propositions is increasingly difficult as they can offer *too many* solutions. Consequently the market is not aware of the possibilities his organizations offer, resulting in fewer sales than possible. Furthermore, as the people performing the innovative activity within his organization are also the people who sense the market needs, combined with the fact that his organization doesn't have an innovative (i.e. R&D) department, makes his statements difficult to place in this context.

All in all, the interviewees indicate market-understanding is necessary in the R&D department, but the capabilities needed to obtain that knowledge are mainly placed in customer-facing units. The interviewees suggest that it is the responsibility of their CFU's to communicate this information to their development teams. This is also the case with the market interaction capabilities; the sales and marketing teams are the main teams responsible for interacting with customers and the market, and are therefore the main teams developing those specific capabilities. But, as interviewee 5 exemplifies, there are firms where market-understanding and interaction capabilities have been developed within R&D teams. So it can be argued that these capabilities are developed within R&D teams to a very small extent.

Quote Box 2

Market- understanding & interaction capabilities

Interviewee 5

"We have our sales force and our technical people and they all go to the customer and go to the market and they identify needs. [...] We analyse the market and look for market needs; if that market is big enough or has potential, we develop solutions for that market. [...] We often engage in co-development with customers; we do this with key account managers that address big markets and we develop specific solutions for them to address their market needs."

Interviewee 6

"The customer interacting units communicate with customers to find market needs and look for interesting opportunities which are then translated back to our technology departments to develop them."

Interviewee 2

"As our organizations provide services to our customers, which is often a single customer, we identify possibilities for innovations and develop those in-house. The service departments are most of the times the one with thorough market understanding. [...] The customer is usually not actively involved in this development process."

"We basically can offer any solution to our customers, yet showing that is a challenge. [...] For instance when having a booth on a conference, we can show just a hand-full of possibilities without people becoming overwhelmed with information. But for customers to truly understand we can offer anything remains difficult."

Interviewee 10

“In our organization, R&D should listen more to our marketing and sales departments as they need a better market understanding. [...] Sales and marketing are the ones that interact with the customers, thus other departments, i.e. R&D, should communicate with sales and marketing.”

Information management & communication

The information management & communication capability dimension can be best described as enveloping capabilities that enable efficient internal communications, knowledge exchange and cross-departmental cooperation. Placed in the context of the front-end by Storbacka (2011) this dimension seemed somewhat vague to the interviewees as all of them emphasized the importance of having good communicative capabilities. After explaining this dimension focuses on internal communication regarding market knowledge between customer facing units and back-end developing units, interviewees seemed more confident in their answers.

The interviewees especially agree on the need for internal communication between departments, more so than before with the silo organizational structure. More specifically, obtaining and exchanging market information is mainly a function for the customer interacting units, implying the internal communicative capabilities to enable this knowledge flow are developed within these front-end units. This is also the case for cross-departmental cooperation, as is exemplified by interviewee 8.

Interviewee 9, however, suggests that these capabilities, based on the maturity of the organization, should be developed within the R&D department, or teams, in the earlier stages of the transition toward becoming a solution provider. This interviewee was mainly referring to the capabilities within this dimension, defined by Storbacka (2011) as *value verification* capabilities, shown in table 4: “the ability to collect and share benchmark data throughout the firm” and “the ability to document solutions for redeployment”. As the organization of interviewee 9 arguably is more mature in terms of transitioning to a solution provider, his statement should not be taken lightly.

It can thus be argued that this capability dimension, and with that the capabilities it envelops, are mainly developed by the customer facing units and departments, which are also tasked with initiating and guiding cross-departmental cooperation. However, it may be wise for an organization in the earlier stages of the transition process towards becoming a solution provider to discuss and contemplate whether some of the capabilities in this dimension should first be developed in the back-end, or more specifically the R&D department or related teams.

Quote Box 3

Information management & communications capabilities

Interviewee 3

"The market data showed some opportunities with second-hand car sales. These opportunities were tested and then translated into requirements to our central development teams. [...] Afterwards our local units are tasked with selling and communicate these developments."

Interviewee 8

"Departments within our organization are now much more cooperative then before. [...] It would hurt the working environment if people thought like that [referring to a "silo"-structure within development] as it needs the input of all of our employees. [...] Our operational units, so the marketing and sales units, are responsible for communicating and combining other departments to develop and deliver solutions."

Interviewee 9

"It depends on the matureness of the organization [...] early in the transition process towards solutions, these capabilities are developed in strategic centralized departments, in this case back-end or development departments. [...] Further in the process an organization can contemplate whether to develop these capabilities closer to the market."

Sales & delivery

The sales & delivery capability dimension can be best described as enveloping capabilities that enable account management, a solution sales-force, and effective delivery of solutions, both in terms of monitoring and after-sales services. As this dimension is described using keywords that usually refer to sales, marketing and customer interacting departments, the interviewees were told two to three examples of concrete capabilities from table 4 to assure the consideration of these capabilities within the context of the R&D department within their organizations.

The interviewees unanimously stated that these capabilities were completely developed by their customer facing units, mainly described as either their service/maintenance or sales departments. The quote box exemplifies the strong statements that place the development of these capability dimensions completely in other than R&D departments or teams. Thus, the conclusion that this capability dimension is not developed whatsoever in the R&D department or teams seems warranted.

Quote Box 4 *Sales & delivery capabilities*

Interviewee 5

“When we have developed a product of certain markets we check our products, every now and then, against the current market needs. We test our product and look if the product is addressing the market needs or if there are additional problems for the customer. [...] Our services department sees these problems first as they visit the customer regularly.”

Interviewee 2

“All our products and services are focused on asset-management [...] we have extensive customer interaction and can identify exactly when certain solutions are not meeting customers needs. [...] This is all done by our maintenance services department.”

Interviewee 3

“As our approach has changed to a more service and customer focus, we have put greater emphasize on account management and consulting capabilities. [...] Our sales teams are the main effectors of these responsibilities. [...] Our R&D department is not involved in selling or delivery of solutions, verification of solution value is implicitly the task of our operational services department.”

6.2 Back-end Capability Dimensions

The following section discusses the findings from the interviews, specifically regarding the capabilities that the literature has defined as back-end capabilities. The capability dimensions and specific capabilities are shown in tables 6 and 7.

Solution configuration and Standardization

The solution configuration and standardization capability dimension can be best described as enveloping capabilities that enable the development of solution configurations (i.e. platforms), standardized components and codification of both the configurations and the solution components. What became apparent from the interviewees was that the reality of their organizations differs, some more than others, from the situation described in the solutions literature, with regards to customization and standardization.

As interviewee 9 states, his organization is in the process of learning how to develop solutions and make them scalable. During the interview, he confirmed the standardization is something his organization is aiming for, but according to him it's rather a challenge. Especially with keeping the balance between delivering customized solutions while keeping a larger part of them standardized. Interviewee 1, being an expert on how solution providers should work,

confirms the statement of interviewee 9 that the standardization capabilities should be developed within R&D departments, or teams.

Yet, Interviewee 7 offers a perspective that was more common with the interviewees; services are the added components used for customization. More specifically, the product is developed, which is standard for all customers, yet the services added to the mix are different for each customer, offering them a customized solution. Based on these findings, the statements by Davies et al. (2006) that argue standardized product and service components should be developed and then integrated remain a goal rather than reality.

Either way, the interviewees agree that this capability dimension with the included capabilities should all be developed in the R&D department, or innovative teams. Which is conform to the literature and offers therefore no surprises.

Quote Box 5 *Solution configuration and standardization capabilities*

Interviewee 9

"We are currently in that exact process; how to develop scalable solutions. Our local units offer very customized solutions, which is great, but the business question at the moment is 'how can we keep the highly customized solution development while keeping them scalable globally?'. [...] I expect these capabilities will be developed in a more global centralized R&D department."

Interviewee 1

"A distinction between 'one-of-a-kind'- and 'first-of-a-kind'-solutions should be made by the customer-facing units, after which the R&D department, or innovative teams, should develop standardized components, extracted from the first-of-a-kind-solution."

Interviewee 7

"Services within our organization are added, by our services department, after the product is finished being developed. [...] You could say the product is the standardized component after which the services are used to customize the solution offering for customers."

Customer insight and deployment capabilities

The customer insight and deployment capability dimension can be best described as enveloping capabilities that enable the use and development of customer insight and interaction in the solution development and deployment process. All interviewees in this

research were keen on emphasizing their customer focus in the development process, but it became apparent each organization has a different approach with customer focus in the development.

As interviewee 5 and 4 state, their development process is done by using actual market driven and customer-focused data. Interviewee 5 stated in an earlier quote (quote box 2) that the technical people in his organization are also actively involved in obtaining customer insight. Combined with his quote in box 5 it can be concluded their R&D department uses a direct and first-hand approach on obtaining customer insight for the development process.

As interviewee 2 and 3 exemplify, the first stages of the development is started and done *purely* from their R&D department, before involving their customers. Although interviewee 2 claims they *should* involve their customers earlier in the development process, interviewee 3 shows his organization is only concerned with customer involvement when the development process is further along.

Arguably interviewee 2 and 3 obtain customer insight while testing the solutions, done by the customer facing units, means these capabilities are not developed in the R&D department of their firms. However, as interviewee 5 and 4 show, these capabilities can be developed within the R&D department, therefore it can be concluded this dimension and its capabilities are developed within R&D departments to a medium extend.

Quote Box 6 *Customer insight and deployment capabilities*

Interviewee 2

"A large proportion of our innovation comes from our engineers, from a technological point of view. [...] However we feel it's important to involve our customers earlier in the development process. [...] Our service delivering departments do have a good interaction with the customer and they are capable of identifying new market needs."

Interviewee 5

"Our development is market driven. We analyze the market and look for market needs, when we have identified a market need with enough potential we develop solutions for that market. This is all done by our development teams. [...] The monitoring and deployment is done by our account managers."

Interviewee 4

“We have a new approach; it’s a once-a-month-meeting where we have our [local] R&D departments meeting. [...] With this new approach we gain more insight from the different local markets and patents. This is different from earlier years where we just looked at technological possibilities, but now this customer approach comes from these local R&D units.”

Interviewee 3

“We develop a solution and its proposition in-house and then test it in the market before scaling it up. Thus the customer is involved, but not in the first phases [...] after the ideas have been developed internally.”

Pricing and risk assessment

The pricing and risk assessment capability dimension can be best described as enveloping capabilities that enable in-depth understanding of the solution value for the customer and translate this into pricing categories, component costing data and risks for the organization. It should be noted that while this dimension is found in the back-end, based on the literature, the interviewees seemed certain in saying the risk assessment was mainly done by their strategic departments or teams, which are based in the strategic center according to the literature.

Nevertheless, as exemplified by interviewee 9, the development of pricing disciplines and models is done by their R&D teams, which are then translated into specific and concrete pricing of the solutions by their customer units. Yet, interviewee 10 argues that their R&D units are in no way involved in the pricing and risk assessment, as their sales units are tasked with value identification of their customers and are thus best suited to price solutions accordingly.

Based on these interviews, it can be argued that this capability dimension is developed to some extent by the R&D department, or teams.

Quote Box 7

Pricing and risk assessment capabilities

Interviewee 9

“The concrete translation of pricing and risks with services and solutions is done from a local perspective by our customer units, but the creation of pricing disciplines and models is done by our R&D-like units. While risks are interpreted by our overarching strategy unit”

Interviewee 10

“The pricing of a solution as such is done by our sales units as they are also actively working on interpreting the value identification of certain added services by our customer; whether the customer actually understands the added value of the added service. [...] If the customer doesn't see the value of an expensive added service we choose to not deliver that service to that particular customer.”

Communication

The communication capability dimension can be best described as enveloping capabilities that enable effective communication internally, with the front-end regarding supply and development of solutions, and externally, with suppliers and partners regarding development opportunities. In this case, all interviewees focused on innovation with other organizations and institutions which is surprising as the literature regarding capabilities (Storbacka 2011; Davies et al. 2006; Brady et al. 2005) don't explicitly focus on network capabilities for innovation. However, other articles do imply network capabilities with the development of solutions (Windahl & Lakemond 2006; Epp & Price 2011). Nevertheless, two things become apparent from the interviews: 1) networking seems a significant part of their development process, and 2) organizations may acquire if they don't have the skills to forge alliances.

As interviewees 2 and 5 exemplify, their organizations feel strongly about developing networking capabilities as they see it's crucial to cooperate with innovation and/or use external technologies to support the development of their own solutions. This falls in line with the multi-vendor system integration as described by Davies et al. (2006), which claimed organizations need to search externally to identify technologies which can be used in their solution to increase value for the customer.

Interviewee 7 was the only interviewee that explicitly didn't mention networking and external communications in their development process. As can be seen in quote box 8, interviewee 7 stated his organization develops all technology and knowledge within his own organization, and if that is insufficient, knowledge is acquired by taking over other companies.

Interviewee 3 exemplifies a situation where the organization communicates solely through their partners, which is done by their customer units except when supplying their partners with a solution. More specifically, when supplying their partners with a solution, the development teams help their partners understand that solution so they, in turn, can supply the solution to their customers.

Based on these findings, two conclusions can be drawn: 1) networking capabilities although not explicitly mentioned are perceived to be crucial for the interviewed organizations,

and 2) very little other communication capabilities are developed within the R&D department. Arguably this capability dimension, as it was formulated when starting this research, is only developed in the R&D department, or teams, to some extent. However, when including networking capabilities within this dimension, which seems warranted as networking capabilities are arguably communication capabilities, it is developed within the R&D department to a large extend.

Quote Box 8 *Communication capabilities*

Interviewee 2

"Our main goal for the innovative unit is to build a network with institutes and other firms with whom we can accomplish our goals. [...] For this, the main capability should be communication skills to be able to forge alliances externally. [...] Our innovative unit also needs communication skills internally to make sure the right hand knows what the left hand is doing."

Interviewee 7

"We develop all our knowledge in-house [...] any competences we do not have we acquire. As an example, we recently bought a robot supplier to assist in our logistics. We do this for all knowledge we need that is hard to develop and very specialized."

Interviewee 3

"Our dealer network is our main way of reaching the customer, which means our customer units are the ones that focus on the communication with these partners. Our development department develops a solution completely and then delivers that to our network partners, which then deliver our solution to their dealers."

Interviewee 5

"When you look at our world, our fast-changing world, you cannot develop everything on your own. When you look into the market, you have to see what's available outside. [...] Now we have in every research department a unit called scouting and incubation. We look for technologies outside and what can be of value to [our organization] and our research division."

6.3 Capabilities within the R&D department

Based on the findings explicated in 6.1 and 6.2 a clear formulation can be made, summarized in table 10, to what extent the capability dimensions from table 5 and 7 are developed within the R&D department, or teams. The 5 point scale, as explained in the research process section of this paper, is interpreted based on the answers of the interviewees. Note that this qualitative interpretation is taken from the interviewees, if they provided it explicitly, in the other cases the interpretation was done by analyzing the responses of the interviewees and identifying the amount of capabilities

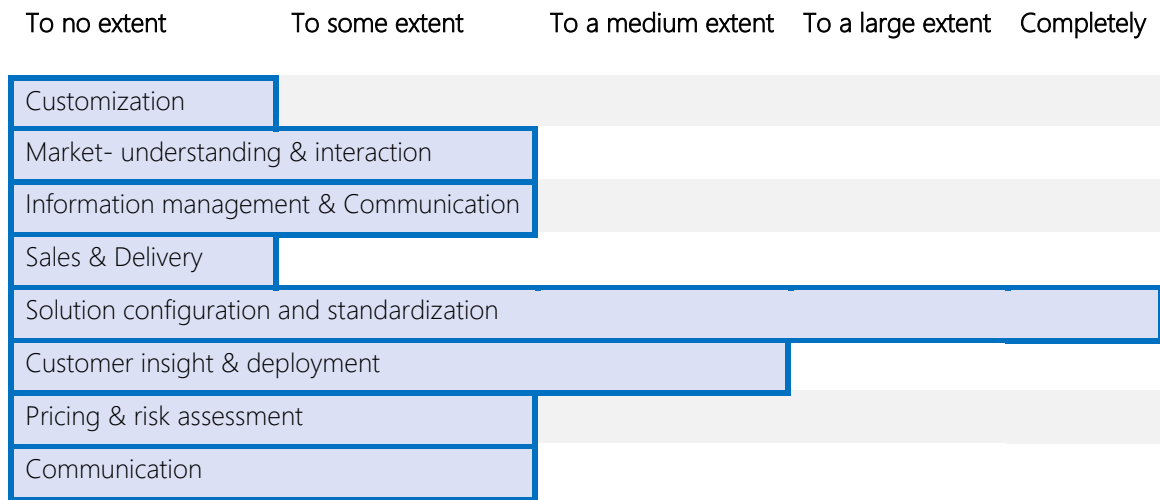


Table 10: Summary of each capability dimension, graded to what extent that dimension has been developed within the R&D department, or teams.

If mentioned in the interviews, the specific capabilities within these dimensions, developed within the R&D department, or teams, are described in table 12.

Capability Dimension	Specific capabilities mentioned for R&D departments
Customization	No specific capabilities; none of these capabilities is developed in R&D departments
Market- understanding & interaction	<ul style="list-style-type: none"> • Application knowledge development • Customer involvement in development
Information management & communication	<ul style="list-style-type: none"> • Ability to combine marketing and product management • Ability to collect and share benchmark data • Ability to document solutions for redeployment
Sales & Delivery	No specific capabilities; none of these capabilities is developed in R&D departments
Solution configuration & standardization	No specific capabilities; this dimension is completely developed in R&D departments

Customer insight & deployment	<ul style="list-style-type: none"> • Application knowledge development • Ability to let customer insight drive development • Ability to analyze business cases
Pricing & risk assessment	<ul style="list-style-type: none"> • Ability to provide costing data for solutions
Communication	<ul style="list-style-type: none"> • Networking capabilities (both internal and external) • Ability to communicate info regarding available solutions • Ability to manage supplier/partner network

Table 11: Summary of specific capabilities mentioned by the interviewees that have been developed by the R&D departments, or teams, categorized within their respective dimension.

6.4 Newly identified capabilities

In this section all capabilities, mentioned by the interviewed managers that weren't already explicitly mentioned in the literature, are described and then categorized in which dimension they belong.

Application knowledge development

During two separate interviews there was a mentioning of application knowledge development. Interviewee 1 described application knowledge development as: "People that are involved with solution development should have a clear and in-depth knowledge on the application domain." As interviewee 1 is an expert on solution consultancy it is surprising that this specific capability is not included somewhere in the literature. The literature does explicate the importance of a customer focus, and mentions customer insight in the back-end and front-end but these focus mainly on understanding the needs in the market or the value of a solution for the customer. Take for instance the capability described by Storbacka (2011) as "Ability to let customer insight drive the development process". This capability describes involving customer insight when developing, which is closely related to application knowledge development, however this capability doesn't explicitly describes a firms' ability to understand the domain in which their solutions are put to use.

As interviewee 9 confirms, having an in-depth understanding of the application domain of a solution significantly better the development. Interviewee 9 stated that his organization is actively doing fundamental research in an attempt to gain more knowledge on the application domain. Furthermore, Interviewee 1 argues that a good way to obtain this knowledge is by having experts from the field, ones that have many years of experience and who give advice about that certain field, included in the development process. He gave a hospital as an example: with customer involvement in the development process it is possible to find implicit needs and problems, yet by having intricate and expert knowledge on how exactly the processes within a hospital take place, a firm is extremely more able to identify opportunities to provide solutions.

Both interviewees agree that this knowledge, and with that the capability to obtain that knowledge, should be developed within the R&D department, or teams, within the organization. If so, based on the description of the dimensions, this capability best fits within the Customer insight & deployment dimension from the back-end. This would mean that the customer insight & deployment capability dimension is developed within R&D departments or teams to a large extent, as is shown in table 11.

Quote Box 9 *Application knowledge development*

Interviewee 1

“People that are involved with solution development should have a clear and in-depth knowledge on the application domain. These should be people that exactly know, from years of experience of working there and who give advice to firms in that domain, how these firms operate and which problems they encounter [...] As this consists of *real* knowledge, it should be logical that this knowledge should be within the R&D units.”

Interviewee 9

“If R&D units don’t have this kind of knowledge they have no concrete knowledge on how their solutions are being put to use. [...] We try to accommodate this by doing *real* research to create a direct relation with the market and application domain and to include this in the development process, but we also try to provide them, through our customer units, with information of the market.”

Networking capabilities

As discussed when regarding the communication capability dimension in section 6.2, interviewees agreed that R&D departments and teams are increasingly involved in forging alliances for joint innovation and development of solutions. The excerpts from the interviews that specifically mentioned these capabilities are shown in quote box 10. Based on these excerpts the network capabilities can be described as “capabilities that enable the forging of alliance with external partners in efforts to exchange knowledge and facilitate joint innovations”.

These capabilities are mentioned by the interviewees as part of the communication capability dimension and, based on the definition of this dimension, the inclusion of the networking capabilities in the communication capability dimension seems warranted. Consequently, the extent to which this dimension is developed within R&D departments or teams is increased to a large extent.

Quote Box 10 *Networking capabilities*

Interviewee 2

“Our main goal for the innovative unit is to build a network with institutes and other firms with whom we can accomplish our goals. [...] For this, the main capability should be communication skills to be able to forge alliances externally. [...] Our innovative unit also needs communication skills internally to make sure the right hand knows what the left hand is doing.”

Interviewee 5

“When you look at our world, our fast-changing world, you cannot develop everything on your own. When you look into the market, you have to see what’s available outside. [...] Now we have in every research department a unit called scouting and incubation. We look for technologies outside and what can be of value to [our organization] and our research division.”

Based on the addition of both capabilities, networking and application knowledge development, within the capability dimensions, communication dimension and customer insight & deployment dimension respectively, result a revised table showing to what extent each dimension is developed within the R&D department or teams. This revised table is shown below in table 12.

To no extent	To some extent	To a medium extent	To a large extent	Completely
Customization				
Market- understanding & interaction				
Information management & Communication				
Sales & Delivery				
Solution configuration and standardization capabilities				
Customer insight & deployment			Application knowledge development	
Pricing & risk assessment				
Communication		Network Capabilities		

Table 12: Revised capability dimension table, including application knowledge development and network capabilities presented in orange, graded to what extent that dimension has been developed within the R&D department, or teams.

6.5 Concluding model

Based on the results, as presented in the previous sections, the conceptual model can now be improved by filling in the gaps of the conceptual model. More specifically, the capability dimensions, from the back-end, that are mainly developed within the R&D department are now described in the dark blue rectangle. Furthermore, the front-end capability dimensions that have been developed to some extent in the R&D department are described in the dashed-red rectangle. And finally, the newly identified capabilities, developed within the R&D department, are described in the dashed-blue rectangle.

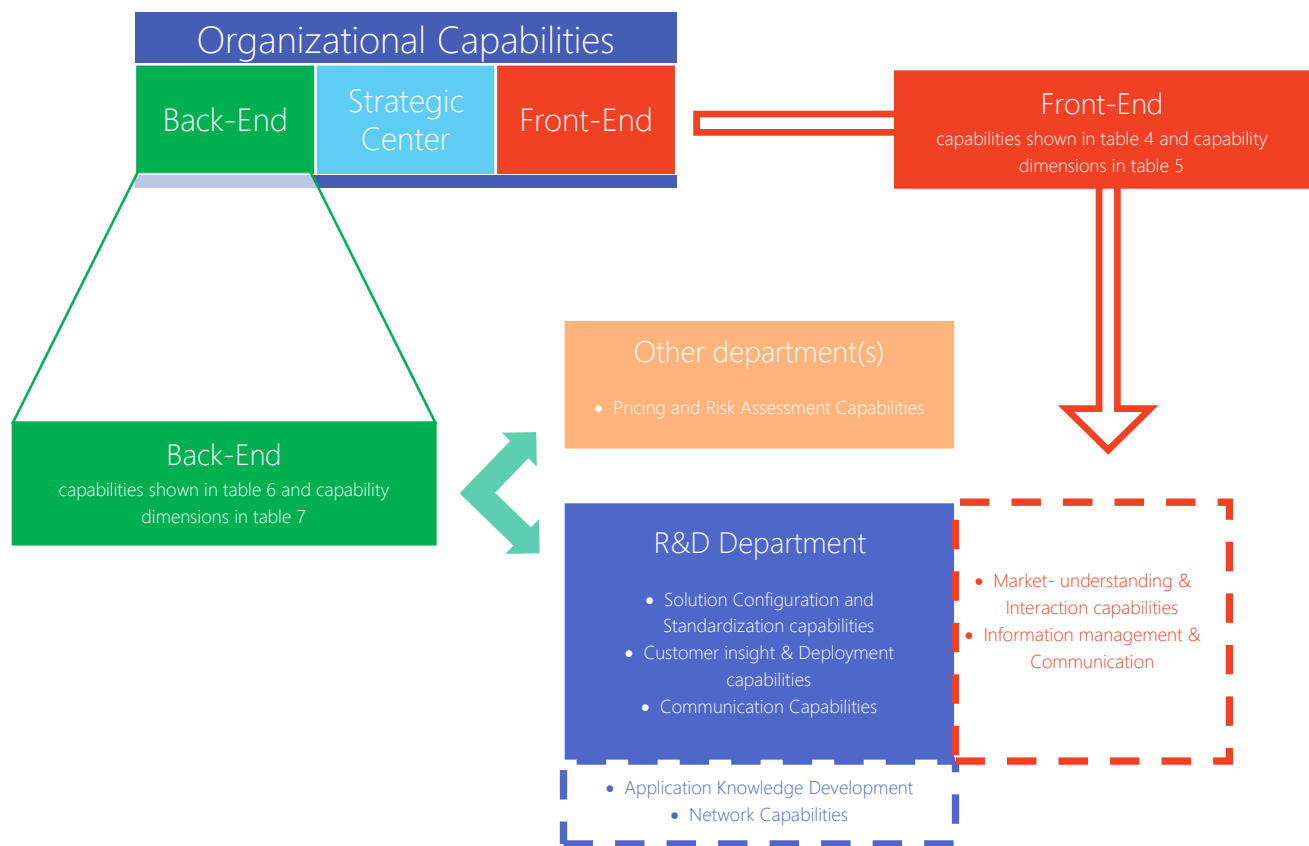


Figure 7: Concluding model, based on the conceptual model, summarizes the findings by combining the results shown in table 11 with the gaps in the conceptual model. The "Other department(s)" rectangle has been shaded as it is not an integral focus of this research paper.

In short, figure 7 summarizes the identified capability dimensions and the newly identified capabilities as a result of this research paper. Note that the dark blue rectangle together with the dashed, both red and blue, rectangles exemplify the total R&D department, or when a company is differently structured the teams within that organization tasked with the innovative activities, and the capabilities developed within that department or teams.

7. Discussion

7.1 General conclusions

This research paper set out to investigate what capability dimensions, based on the capabilities identified by previous studies (Storbacka 2011; Brady et al. 2005; Davies et al. 2006), are developed within R&D departments, or teams undertaking the innovative activities within the firm. Despite the business importance of generating and managing solutions, prior research has only provided an organization-wide perspective on the capabilities firms have developed, or need to develop (Windahl et al. 2004; Davies et al. 2006; Davies et al. 2001). The findings from this research offer a more concrete insight in what capabilities have been developed within a specific part of the organization, in this case the R&D department, or R&D related teams.

First and foremost, the findings confirm the move of the R&D department, as part of the development process, towards the front-end, as two of the four front-end capability dimensions, namely *market- understanding & interaction* and *information management & communication*, are to some extent developed within the R&D department of the firms interviewed. As Davies et al. (2006) and Storbacka (2011) mention in their articles, with the transition towards solutions, firms begin to understand the increasing importance of including the customer in the development process. It is therefore logical to expect the department or teams tasked with developing new products (or services), usually the R&D department, to move towards the front-end for a more direct interaction with the customer. Yet, although previous studies have argued this is the case (Brady et al. 2005; Marks et al. 2011; Kindström 2010; Raddats & Burton 2011; Windahl et al. 2004), no explicit results have confirmed this effect. Until now; this paper shows that capabilities, identified as being in the front-end, have been developed by the R&D department, or teams undertaking the innovative activities within the firm, signaling the shift of the R&D department towards the front-end, and with that towards the customer.

Second, the findings also show the importance of customer insight within the development process, and more specifically within R&D departments, when providing solutions. Not only is this exemplified by the identification of a *new* capability, namely the *application knowledge development capability*, but also because the capability dimension, in which this capability is categorized, is developed within the R&D department to the second highest extent (see table 11). Most surprising about the identification of this (previously unmentioned) capability is just that, that it wasn't identified in previous studies (Storbacka 2011; Brady et al. 2005; Davies et al. 2006). These same studies argue that customer-centric development is key in offering solutions, however they remain somewhat implicit when it comes to capabilities that enable firms to gain customer insight. More specifically, Storbacka (2011) explicitly mentions the *ability to let customer insight drive the development process*, which is arguably the customer-centric focus, however he describes this capability as *the solution development process should focus on*

customers' processes and financial drivers. Consequently, Storbacka (2011) remains silent on how exactly this should be done and whether or not firms should understand the application domain of their solutions. As some interviewees confirmed, interacting with the customer is crucial for the development of solutions, but the interviewees took it even further stating that firms should look beyond the customer and understand the domain in which their solution is put to use. They argue that expert knowledge on the application domain provides firms with the *truly* in-depth knowledge that enables them to develop and offer *true* solutions for their customer.

Third, the *communication* capability dimension seems under-investigated by previous literature, as some interviewees described the need for communication skills that enable their R&D departments to form alliances with other knowledge creators to increase development opportunities. As the interviewees stressed (quote box 10): these networking capabilities are increasingly important as the development speed of products, technologies and services are increasing. And in order to provide customers with solutions of the highest value, alliances need to be forged to enable more efficient development processes. Windahl & Lakemond (2006) do discuss the importance of an organizations' network in the development of solutions, but focus mainly on the challenges of solution development with regards to the organizations' network. Consequently, they don't discuss the capabilities needed within an organization, just the factors related, to form good relationships within the network. Davies et al. (2006) also lightly touches on this subject, in terms of multi-vendor system integration, but generally all studies have ignored, or at least didn't mention, the importance of network capabilities in the R&D departments, or teams, of solution providers.

7.2 Contributions

Theoretical

This paper contributes to the literature in two ways. First, continuing on the identification and explication of the capabilities developed within solution providers by Brady et al. (2005), Davies et al. (2006) and Storbacka (2011), capability dimensions have been interpreted, combining all three studies. These capability dimensions have then been checked with senior managers in the field to assess to what extent these dimensions have been developed within their R&D department, or within the teams undertaking innovative activities. Based on those findings, conclusions have been drawn, arguing that *solution configuration & standardization*, *customer insight & deployment* and *communication* capability dimensions are the main dimensions that are developed within the R&D departments, or related teams. But most importantly, before this research paper the solutions literature had only a global understanding of what capabilities are developed within solutions providers; by identifying what capabilities are developed within a specific department the solution literature is provided with a more concrete understanding of how these capabilities are situated within solutions providers.

Second, this paper has identified two specific capabilities that previous studies have missed, or ignored, in their research: *application knowledge development* and *networking capabilities*. These capabilities have been categorized within two dimensions, *customer insight & deployment* and *communication* respectively, expanding the existing literature with a more comprehensive perspective on the capabilities solution providers develop. According to some of the interviewed managers, these capabilities are also developed within their R&D departments, and are increasingly important with the move towards becoming a solution provider.

Managerial

Overall, this research continues on the importance of cross-functional alignment with firms, argued by Storbacka (2011), by extending the knowledge on the coordination of resources and business processes within the R&D departments, or related teams. Practically, this research offers managers with a concrete overview on what capabilities they should focus on developing within their R&D department, or related teams. As previous studies already suggested, firms are experiencing increasing pressures to adopt different strategies, one of which is servitization, but offers little practical assistance in how to do so (Storbacka 2011; Baines et al. 2009; Brady et al. 2005).

This research offers guidelines on what capabilities a firm should request from and develop within their R&D departments, or related teams, to improve their ability to develop and deliver solutions. More specifically, managers are now able to assess what capabilities their R&D departments, or teams, have already developed and which capabilities, based on this research paper, their R&D departments, or teams, still lack. Following this assessment, managers have a clear-cut understanding of what capabilities other solution providers have developed in their R&D departments, that they lack, and thus where the focus of their transition, with regards to their R&D department or teams, should lie.

8. Suggestions for Company X

Returning to the request of Company X for this research paper; to expand their knowledge on solution development, more specifically what capabilities their R&D department could develop to support and facilitate the successful development of solutions. The conclusions from this paper offer Company X two implications: 1) a broad overview on the capabilities developed within solution providers, combined with the specific capabilities developed within their respective R&D department or teams, and 2) some preliminary suggestion can be provided, specifically what capabilities can be developed or what barriers may be encountered in their development by Company X Research.

First, the broad overview provided by this research paper, as explicated in the findings section, offers Company X some handles in the assessment of their R&D department. More specifically, as this research paper focused mainly on identifying what capabilities *other* firms developed within their research departments, translating this for Company X can only be done to some degree. Ultimately, Company X remains the authority on what capabilities already exist within their R&D department and how new capabilities are developed. Consequently, by providing an overview of the capabilities other solution providers have developed, Company X is able to translate these findings specifically for their own R&D department. Therefore, this paper suggests Company X to assess what capabilities already reside within their R&D department and compare this with the capabilities identified by this paper as capabilities within R&D departments.

Second, this research paper stresses that some capabilities and related barriers for Company X can already be identified. One of the main capabilities and barrier for Company X would be the customer-focused development process. [REDACTED]

[REDACTED] the literature argues *true* solution providers structure themselves around the customer, [REDACTED]

[REDACTED] Workman (1993) argues that within high-tech firms, or from a broader perspective engineering intensive firms, marketing plays a neglectable role in product development. It can be argued that Company X is an engineering intensive firms in which product development is mostly performed by their R&D department [REDACTED]

[REDACTED] Consequently, a significant barrier for the R&D department of Company X [REDACTED] will be to restructure and redevelop its strengths and capabilities in such a way to be able to better include a customers' perspective in the development of their products, and solutions.

More concretely, this paper suggests Company X to develop capabilities from the *Customer insight & deployment* capability dimension. To give some specific suggestions [REDACTED]

[REDACTED] and 2)

Company X should develop their *ability to let customer insight drive the development process*.

[REDACTED]

[REDACTED] Furthermore, Company X traditionally let their R&D department “push” new products, but to offer solutions Company X should develop capabilities to let customer insight drive the development process. Consequently, Company X should focus on developing that specific capability before moving forward in offering solutions.

Having said that, Company X already has a key capability that can be useful when it comes to offering solutions: networking capabilities. For instance, [REDACTED] [REDACTED], Company X has strengthened its network with closely located technology firms. Furthermore, Company X has proved their ability to form alliances in the past [REDACTED] [REDACTED]. Not only that, but with these alliances Company X was able to produce new products that have successfully gained marketshare. [REDACTED]

Some interviewees of this study argued that networking capabilities are needed to exchange knowledge. Arguably exchanging technological (or product related) knowledge is not a novel endeavor for Company X, however Company X needs to refocus their networking capabilities to incorporate knowledge exchange, or knowledge creation, with regards to value adding services, or solution components.

[REDACTED]

[REDACTED] According to him these people will become increasingly important as a hinge between what he described as Application knowledge development and Available Technologies. In short, experts with knowledge on the application domain, usually within the field in which the solution will be applied, and experts with intimate knowledge on what possibilities reside with current technologies, usually within a firms’ own R&D department, need to be connected in order to develop a successful solution. Currently Company X has instated some [REDACTED], which are currently actively involved in the knowledge development within the R&D department of Company X regarding solution development. Possibly this could be a wise initial step of Company X in the right direction [REDACTED]

[REDACTED]

Finally, this paper stresses the need for Company X to expand their understanding further with regards to customer interaction/involvement in the development of product, services and combinations thereof. More importantly, for Company X to develop capabilities related to customer understanding and interaction their R&D – Marketing communication and cooperation should be strengthened, as this will prove crucial when transitioning towards a solution provider. In short, Company X' first priority should lie with including more marketing capabilities, or even marketing personnel, within their development teams to prepare Company X for a shift towards customer-centric development.

9. Limitations and further research

As is the case for any thesis project, the choices in the research process created some limitations, some of which can offer possible directions for future research. The qualitative nature of this study provides some suggestions, but generalization is difficult as the conclusions of this study are based on a limited sample. Although this study has exposed previously unidentified capabilities within solution providers, empirical quantitative verification would be a natural next step.

The intention of this study was to make a first step in the direction to identify and provide a more concrete description of which capabilities should be developed in what specific department within firms transitioning towards solutions. Furthermore, all but one interviewee in this study were R&D related senior management. It could prove helpful to view the development of capabilities within specific departments, like in this paper the R&D department, from a strategic management perspective as that might expose the thought process behind what capabilities are developed in what department. However, as some interviewees noted, the capabilities might first be developed in a certain part of the organization temporarily, to be developed in another department, for the long term, at a later date. A better understanding on how this process takes place and in what way the capabilities are developed may offer opportunities to improve this process.

A key issue remains, possibly also with future empirical verification, is the managers' interpretation of the capability definitions correct? Interviewees in this study seemed to need (a lot) clarification with some of the capability dimensions. This suggests that either managers have their own definitions and descriptions of the capabilities, or they have no exact understanding of what capabilities are developed within their department or firm. For this study, the interpretation of the capability dimensions, and their specific capabilities, by the interviewees was accepted, unless they asked for clarification. In that case, the interviewee received the definition as formulated by this study. The key argument for this choice was that many different formulations exist for capabilities; more restrictive questions might have resulted in more agreeing answers, rather than original responses by the interviewees.

The choice for considering only large corporations, based on suggestions in the literature, excludes the possibility of generalizing these findings for SME's. Consequently, both SME's, interested in transitioning towards solutions, and the solution literature need a better and concrete understanding of what capabilities are developed within SME's and within what departments they are developed.

Seeing that Company X is still on the very beginning of transitioning towards solutions, their understanding and knowledge on this subject is rather elementary, but growing.

Consequently, the problem statement of Company X is quite broad and meant to deepen their understanding of solutions in general. This resulted in a more broad study, rather than a specific research paper on a concrete question. Future research might focus more specifically on a subject to uncover more in-depth conclusions, and with that implications for managers.

Finally, the capabilities, previously unmentioned by the literature, that this study signaled as being developed within some R&D departments have not been mentioned by all interviewees. This does not imply those firms have not developed these capabilities at all or within their R&D department; it may suggest that the interviewees that didn't mention those capabilities either since they don't prioritize those capabilities enough to remember them when the interview took place, or they are not personally involved with the activities within the R&D departments that utilize these capabilities. This again, might be better understood with empirical verification, possibly by using multiple respondents from the same firm to ensure a more complete overview.

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11. Appendices

Appendix A – Summary of definitions, example and linkages between resources and capabilities (Ulaga & Reinartz 2011)

	Definition	Example	Primary Resource Base
Unique Resources			
Installed base product usage and process data	The stock of product usage and customer process data collected through a firm's installed base of goods and/or used in customers' operations.	Forklift truck downtime data.	—
Product development and manufacturing assets	The stock of resources invested in a firm's R&D and manufacturing infrastructure. Product development and manufacturing assets are of tangible and intangible nature.	Patented tire casing.	—
Product sales force and distribution network	The stock of resources tied in a firm's direct sales organization and channel intermediaries to cover its sales territory.	Direct sales force of 600 power tools sales reps.	—
Field service organization	The stock of resources allocated to a network of specialized technicians aimed at deploying and servicing the firm's installed base.	Network of 110 field technicians servicing offset-printing presses.	—
Distinctive Capabilities			
Service-related data processing and interpretation capability	The manufacturer's capacity to analyze and interpret installed base product usage and process data to help customers achieve productivity gains and/or cost reductions.	Analysis of energy consumption in commercial buildings based on data collected from electricity meters.	Installed base product usage and process data
Execution risk assessment and mitigation capability	The manufacturer's capacity to evaluate the uncertainty whether contractually agreed-upon outcomes will be realized and to design and implement safeguarding mechanisms to meet performance commitments while maintaining internal profit targets.	Percentage of correctly operating video screens for inflight entertainment systems in commercial aircrafts.	Installed base product usage and process data
Design-to-service capability	The manufacturer's capacity to integrate tangible and intangible offering elements synergistically to tap its potential for new revenue generation and/or cost reduction.	Reengineering of a laser printer to reduce potential failures and decrease unscheduled maintenance.	Product development and manufacturing assets
Hybrid offering sales capability	The manufacturer's capacity to reach key decision makers in the customer organization, coordinate key contacts in the customer and vendor firms, sell value based on specific documentation and communication tools, and align its sales force with the field organization and channel partners to grow revenues.	Dedicated sales force recruited, trained, and incentivized to sell "tons of iron ore transported" instead of promoting "heavy-duty mining equipment."	Product sales force and distribution network
Hybrid offering deployment capability	The manufacturer's capacity to rely on flexible platforms that allow for standardizing production and delivery processes while safeguarding its ability to adapt to individual customers' needs.	Configuration of six different printer maintenance packages to cover the needs of retail banking customers.	Product development and manufacturing assets field service organization

Appendix B – Table showing the shift from traditional product or service focus towards integrated solutions (Brady et al. 2005)

Company	Traditional product or service focus (1995)	Integrated Solutions (2003)
<i>Alstom Transport</i> Railways	Products: <ul style="list-style-type: none"> • subsystems (e.g. propulsion, traction, drive, electronic information systems) • rolling stock • signalling and train control systems 	Transport solutions (e.g. 'train availability'): <ul style="list-style-type: none"> • Systems integrator – turnkey solutions for project management, fixed infrastructure, and finance • Services for maintenance, renovation, parts replacement & service products – Total Train-Life Management©
<i>Ericsson</i> Mobile Communications Systems	Products: <ul style="list-style-type: none"> • mobile handsets • mobile system • Subsystem products: radio base stations, base station controllers, mobile switches, operating systems, and customer databases 	Turnkey solutions to design, build and operate mobile phone networks: <ul style="list-style-type: none"> • Mobile systems – complete supplier, systems integrator and partner • Global Services – services and business consulting to support a customer's network operations
<i>Thales Training & Simulation</i> Flight Simulation	Products – standalone flight simulators for commercial and military aircraft	Training solutions (e.g. 'pay as you train'): <ul style="list-style-type: none"> • Systems integration • Training services: networked training; independent training centres for training services; and, synthetic training environments
<i>WS Atkins</i> Infrastructure and the Built Environment	Engineering consultancy, project management and technical services for infrastructure projects	Integrated solutions for the built environment: <ul style="list-style-type: none"> • the design, build, finance and operation of infrastructure across industrial sectors Total Solutions for Industry (TS4i) provides one-stop-shop for design, construction, maintenance and finance
<i>Cable & Wireless Global Markets</i> Global Business Telecom Networks	Providing 'managed network services' for multinational corporations <ul style="list-style-type: none"> • Network design • Supply telecom infrastructure and applications • Network management 	Providing 'global outsourcing solutions' for a multinational corporation's entire telecom and IT needs on a global basis: <ul style="list-style-type: none"> • Network design • Supplies telecom infrastructure and applications • Network management • Ownership of the network • Network operation • Business process applications • Service level agreements
<i>BDP</i> Architectural and engineering design services for the built environment	Providing integrated design architectural and engineering design of buildings either directly for a client or to a prime contractor through a design/build approach	Involvement in identifying pre-project requirements for potential facilities, such as schools, development of delivery plans and mechanisms including financial and risk analysis and consortia building. Joint equity partner in project. Design, build, operate, maintain activities once facility has been delivered.

Appendix C - Semi structured interview strategy and questions

Part 1

In the first part of the interview, respondents will be asked to describe their core business and market environment, their view on what a solution entails, the role and scope of solutions within the organization, and how the organization has evolved towards offering solutions (Ulaga & Reinartz 2011).

The questions:

- A. Can you describe the core activities and markets of the firm?
- B. Can you describe what in your view, or in the view of the organization, is meant with a solution?
- C. Where did the need for solutions come from in the firm?
- D. Can you explain how the organization changed with the transition toward customer-centric offering development?

Part 2

In the second part of the interview, respondents will be asked to indicate how the R&D department functions within the firm. To facilitate this process, we will ask the interviewees to give examples of specific situations regarding solution development. This is done to understand the exact meanings of each capability that is required within the R&D department, identified by the managers.

Main objective for this part of the interview is:

- I. To facilitate the emergence of key capabilities within Research & Development, grounded in the managers' own language (Ulaga & Reinartz 2011).

The questions:

- 1.1 Can you describe how the development of a solution is done within the firm? Maybe give an example?
 - o *Goal is to indirectly ask how the process is and find possible leads for further interrogation on R&D*
- 2.1 Which parts of the development process were done by the R&D department? In other words, what is the exact function of the R&D department in your firm with regards to solution development?
 - o *When interviewee doesn't elaborate on R&D processes of the previous question*
- 3.1 Would you say the organization has required 'new' or other capabilities from the R&D department when you started offering/developing solutions?

o *As a start, broader, question to probe whether interviewee understands the concept of capabilities as in the literature.*

- 4.1 The back-end, according to the literature, is responsible for providing solutions-ready components of products and services that can be “mixed and matched” by the front-end (or customer-facing units). The literature also identified what kind of capabilities are needed in the back-end and the front-end. So, when regarding the R&D department in your organization, which of the following capability dimensions are present completely, or to some extent? Can you give an example of these capabilities?

Dimensions - Each dimension will be shortly explained to the interview and examples from the table shall be given to the interviewee upon request, or when the interviewee seems insecure about the meaning of a dimension.

2. Solution configuration & standardization capabilities
 - o Capabilities that enable the development of solution configurations (i.e. platforms), standardized components and codification of both the configurations as the components
3. Customer insight & deployment capabilities
 - o Capabilities that enable the use and development of customer insight and interaction in the solution development and deployment process
4. Pricing and risk assessment capabilities
 - o Capabilities that enable in-depth understanding of the solution value for the customer and translate this into pricing categories, component costing data and risks for the organization
5. Communication capabilities
 - o Capabilities that enable effective communication internally, with the front-end regarding supply and development of solutions, and externally, with suppliers and partners regarding development opportunities
6. Customization capabilities
 - o Capabilities that enable the customization of a solution to customers’ specific needs and showing that to the customer
7. Market- understanding & interaction capabilities
 - o Capabilities that enable an in-depth understanding of the market and its’ implicit needs, and enables market interaction both in the co-development as in the value propositions
8. Information management & communication capabilities
 - o Capabilities that enable efficient internal communications, knowledge exchange and cross-departmental cooperation
9. Sales and delivery capabilities
 - o Capabilities that enable account management, a solution sales-force, and effective delivery of solutions, both in terms of monitoring as after-sales services.

5.1 Would you say there are any other capability requirements for the R&D department that have not been mentioned in this interview yet, that have been asked within your organization?

Appendix D – Specific capabilities and management practices, identified by Storbacka (2011) and categorized in front-end (commercialization), back-end (industrialization) and strategic center (solution platform)

	Develop solutions	Create demand	Sell solution	Deliver solution
Commercialization	<p>Value research:</p> <ul style="list-style-type: none"> Regular planning is carried out with customers. The firm uses research methods to define what is valuable for customers. A goal of the firm is to initiate innovation together with selected customers. Customer value is quantified in the early phases of solution development. Lead customers are involved in idea creation and solution development. There are contract models for lead customer involvement. 	<p>Value proposition:</p> <ul style="list-style-type: none"> Segment specific value propositions have been defined. The role of sales & account management is to work proactively with customers already before they send out a RFQ. The firm co-operates with industry associations to leverage its own visibility. Product managers' campaign plans are developed with sales management. 	<p>Value quantification:</p> <ul style="list-style-type: none"> Customer specific value propositions are linked to customers' business concerns. Dedicated configuration tools are used to create customer-specific solutions. The dialog with the customers' decision makers covers critical business issues and the financial value associated with them. Sales illustrates the value of the solution to the customer. The same tools for quantifying customer value are used across the firm. Identified risks are factored into the pricing of the solution. 	<p>Value verification:</p> <ul style="list-style-type: none"> The sales process ensures accurate input to the order-delivery-process. Contract handover to delivery enables quick ramp up of delivery operations. The value created to the customer is regularly verified. True customer profitability is measured and followed up systematically. References of solution delivery projects are shared through a case repository. New solutions (created for specific customers) are documented in such a way that they can be sold to other customers.
Industrialization	<p>Solutions development:</p> <ul style="list-style-type: none"> Solution development is focused on customers' processes and financial drivers. There is an ability to close the gap between customer needs and the firms' offerings. There is a hierarchical solution structure (e.g. standardized components defined). Standardized solution components are coded in the Enterprise Resource Planning or Product Data Management system. Rules for structuring solutions permit flexible adaptation to customer situations. 	<p>Solutions availability:</p> <ul style="list-style-type: none"> There are predefined solution configurations for different segments. The documentation of configurations is based on results from earlier deliveries. Solutions are priced based on value to customers (not cost plus). There are guidelines for differentiating prices between segments/customers. The performance level that the solutions make possible for customers is specified. The sales and account management organization is regularly updated about the availability of different solutions. 	<p>Solution configuration:</p> <ul style="list-style-type: none"> Configurators are used for configuring customer solutions. There are contract models which support value based pricing of solutions. There is a systematic value based pricing discipline for solutions. Business case analyses (from the provider's point of view) are carried out. There is a centralized tendering unit that provides support for making tenders. Business control supports sales by with standard costing data on solutions and individual solution components. 	<p>Solution delivery:</p> <ul style="list-style-type: none"> A communication process enables the firm to get/provide information from/to the customer at the right time during delivery. Delivery is monitored and corrective actions are taken when delivery is at risk. Network partners' roles are clearly defined in contract models and templates. The interface and communication with partners is clearly defined. Solutions are developed in order to support the customer's long-term value creation.
Solution platform	<p>Strategy planning:</p> <ul style="list-style-type: none"> Solution business vision and goals have been defined by top management. The financial impact of solution business has been estimated to be significant. Focus markets for solution business are defined (e.g. customer groups, industries, geographical areas). There are defined segment strategies (business goals are set and followed up). Solution portfolio management is in place (what solutions to develop, invest in, drop, launch, outsource etc.). The total risks associated with different contracts are assessed regularly. 	<p>Management system:</p> <ul style="list-style-type: none"> The organizational structure enables sales to work efficiently with other functions. The customer dimension is visible in the organizational structure. The current roles and responsibilities enable team work cross-functionally. New roles (e.g. Solution Manager, Solution Architect or Solution Integration Engineer) have been established. Metrics have been defined for measuring and managing solution business. 	<p>Infrastructure support:</p> <ul style="list-style-type: none"> There are specialized intelligence people available to support sales with analyses. Knowledge repositories are used for gathering business intelligence. Customer/model contracts are available in a centralized library. Legal support for contract negotiations is provided (model contracts and/or centralized legal advice). A CRM system supporting solution sales is in active use across the organization. Solution delivery is managed in the ERP (Enterprise Resource Planning) system. 	<p>Human resources management:</p> <ul style="list-style-type: none"> There are defined skill profiles for all the roles that relate to solution sales. Competencies needed in solution business have been identified. The bonus scheme is aligned with company strategy. Bonus schemes reward for cross-functional teamwork (i.e. participating in sales case development, product development). Staff are provided with training in consultative and value selling.