UNIVERSITY OF GOTHENBURG
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Master Degree Project in Innovation and Industrial Management

How can IT Contribute to Servitization in Manufacturing Firms?

An investigation of the strategic role of the IT organization

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ABSTRACT

This work adds to the vast body of literature on servitization in manufacturing firms by investigating the contribution of dynamic capabilities and the strategic role of the IT organization to servitization. Specifically, the study develops three strategic roles the IT organization can play, based on an extensive literature review, and designs indicators which enable the measurement of these roles together with dynamic capabilities. The theoretical foundations were built by performing an extensive literature research on servitization, with focus on dynamic capabilities and Information Technology in particular. Primary data was obtained by executing a web-based survey to collect data on the degree and importance of servitization, the current role of IT and the possession of dynamic capabilities in participating companies. Using cross tabulation and frequency analyses to examine the small sample (N=19), tendencies in the relationships could be found. Most survey respondents expect an increasing importance of Product-Service Systems (PSS) and service orientation for their firms in the future. Manufacturing firms with a strong current service orientation seem to employ dynamic sensing capabilities. A connection between a high service orientation and dynamic seizing or reconfiguring capabilities could not be confirmed. Regarding the role of IT, tendencies towards a positive relationship between a strong Innovation Enabler role of IT and a high importance of the IT organization for PSS development, respectively PSS delivery were discovered. Furthermore, the role of IT as a Solution Integrator appears to be positively related to the importance of IT for PSS delivery. The study concludes with managerial implications for the strategic role of the IT organization against the background of servitization and gives suggestions for the alignment between business and IT.

ZUSAMMENFASSUNG

Diese Arbeit trägt zur umfangreichen, aber noch lange nicht vollständigen Sammlung wissenschaftlicher Arbeiten zum Thema Servitization in Industrieunternehmen bei. Im Detail wurden der Einfluss von dynamischen Fähigkeiten und der strategischen Rolle der IT Organisation auf Servitization untersucht. Basierend auf einer umfangreichen Literaturanalyse wurden drei strategische Rollen entwickelt, die eine IT Organisation einnehmen kann. Für diese Rollen, sowie für die im Rahmen von Servitization besonders wichtigen dynamischen Fähigkeiten, wurden Indikatoren konstruiert um eine Messung zu ermöglichen. Die Sammlung von Primärdaten zur momentanen und zukünftigen Bedeutung von Produkt-Service Systemen (PSS), der Service Orientierung, der Bedeutung der IT Organisation für PSS, als auch zu dynamischen Fähigkeiten und der aktuellen Rolle der IT erfolgte mittels einer Online-Umfrage. Eine deskriptive Auswertung des leider geringen Rücklaufs (N=19) ergab, dass der Großteil der befragten Industrieunternehmen für die Zukunft eine zunehmende Bedeutung von PSS und Service Orientierung erwartet. Umfrageteilnehmer, die eine hohe Service Orientierung angaben, bestätigten den Besitz von dynamischen Sensing-Fähigkeiten, während keine Verbindung zwischen einer hohen Service Orientierung und dynamischen Seizing-, bzw. Reconfiguring-Fähigkeiten nachgewiesen werden konnte. Bezüglich der Rolle der IT scheinen Charakteristika die eine Innovation Enabler Rolle klassifizieren, eine positive Beziehung mit der Bedeutung der IT Organisation für die Entwicklung, als auch Lieferung von PSS zu haben. Die Rolle der IT als Solution Integrator hingegen scheint einen positiven Einfluss auf die Bedeutung der IT Organisation für die Lieferung von PSS zu haben. Letztendlich kommt die Studie zu dem Ergebnis, dass Industrieunternehmen die strategische Rolle der IT Organisation, im speziellen bezüglich der externen Orientierung und Wertschöpfung überdenken sollten, um den unterschiedlichen und oft widersprüchlichen Anforderungen von Servitization gerecht zu werden. Vor diesem Hintergrund wird empfohlen ein besonderes Augenmerk auf die strategische und funktionale Ausrichtung (Alignement) zwischen Business und IT zu legen.

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ABBREVIATIONS

DC	Dynamic Capability
DCF	Dynamic Capability Framework
ERP	Enterprise Resource Planning
ICT	Information and Communication Technology
IS	Information Systems
IT	Information Technology
PSS	Product Service System
RBV	Resource-Based View
RQ	Research Question
SAM	Strategic Alignment Model
SDL	Service Dominant Logic

1 INTRODUCTION

Chapter one briefly discusses the problem under study together with its wider background. The identified research gap is presented, followed by the research questions aiming to address it. Furthermore, the outline of the study, as well as the industry partner, are introduced.

1.1 Problem under Study and Research Gap

Industrial manufacturing firms are increasingly driven to abandon their traditional product-focused business model and move towards a more service-oriented business model (Teece 2010). Reasons that challenge manufacturers to reassess their business logic are among others stagnating markets, growing commoditization, new technological trends, and increasingly demanding customers. (Leseure et al. 2010). According to Grönroos (2000) *"Customers do not look for goods or services per se; they look for solutions that serve their own value-generating processes"* (Grönroos 2000, p.4). In other words, customers increasingly demand complex solutions instead of separate products and services. The transition from a product-oriented to a service-oriented business logic in manufacturing firms became known as servitization (Vandermerwe and Rada 1988).

In recent years, the majority of German and Swiss capital goods industries created only a small percentage of their total revenue through services (72 percent created less than 20 percent and 39 percent even less than 10 percent. (Gebauer and Fleisch 2007) Moreover, around 95 percent of the service revenues came from aftersales activities such as spare parts, maintenance and repair or training services, resulting in only 5 percent from innovative new services (Mahnel and Friedrich 2005; Gustafsson et al. 2010). Innovative services in combination with products are expected to play a crucial role for manufacturers in order to preserve competitiveness in the twenty-first century (Baines and Lightfoot 2013). Information and communication technology (ICT) is the foundation for most of these services and their integration with products (Song et al. 2015; Huang and Rust 2013; Peppard and Ward 2004; Brashear Alejandro et al. 2013; Penttinen and Palmer 2007).

Since the late 1980s, interest in the research field of servitization has grown rapidly (Baines et al. 2009). Major thematic research concerns are product-service differentiation, competitive strategy, customer value, customer relationships, and product-service configuration (Lightfoot et al. 2013). Moreover, previous research in the field has dealt with the transition process (Mathieu 2001b; Penttinen and Palmer 2007) and organizational arrangements (Brashear et al. 2012; Neu and Brown 2005). Even though several authors acknowledge the essential importance of information and communication technology as an enabler for servitization (Neu and Brown 2005; Penttinen and Palmer 2007; Huang and Rust 2013), the contribution of the IT organization, which is usually responsible for its management has rarely been investigated in this context. Consequently, the strategic management and strategic positioning of the IT organization for servitization represents a research gap which this study aims to examine.

1.2 Research Questions

In order to address the identified research gap, this study puts the strategic role of the IT organization in manufacturing firms in the focus of attention. The aim is to differentiate between different strategic roles of the IT organization, develop indicators that allow the measurement and examination of these roles in relation to servitization in manufacturing firms. For the purpose of doing so, the context of servitization and particularly the transition process constitute a necessary framework. The theoretical background of the study is therefore structured in three parts, as reflected by the research questions.

RQ1 Understanding Servitization: What are major drivers, forms, and challenges?
RQ2 What are dynamic capabilities and how can they support servitization?
RQ3 Which strategic role should the IT organization play to enable servitization?

First, servitization is discussed with emphasis on major drivers, forms and challenges. Second, the dynamic capability framework is examined due to its importance for the transition process. The third part is concerned with the strategic role of IT and its contribution to servitization. Furthermore, the objective of this study is to connect

Information Systems (IS) and Information Technology (IT) research to servitization research, as well as to give ideas and suggestions for further research.

1.3 Outline of the Thesis

The study takes a deductive logic of reasoning (*Figure 1*) where theory guides research and therefore the collection of data intends to revise theory (Bryman and Bell 2011).

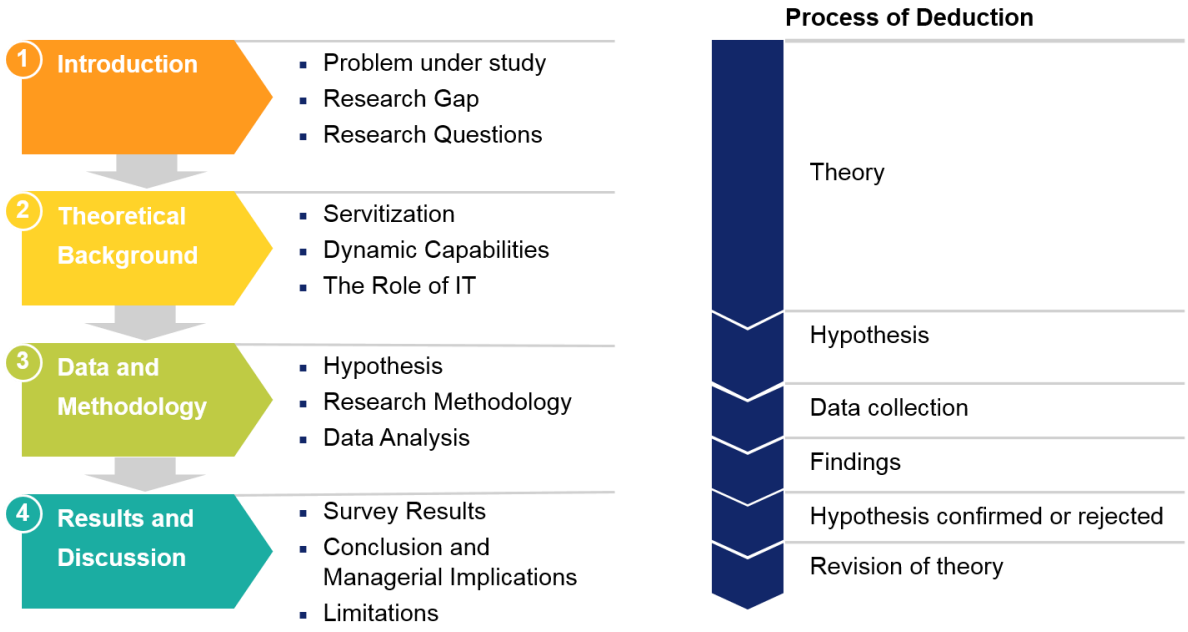

Figure 1: The study follows a deductive process (Bryman and Bell 2011)

In the following chapter two, a detailed theoretical background relevant to understand and connect the complex research fields of servitization and IT / IS research is provided. The theoretical background forms the basis for generating and analyzing the empirical results of this research. After the presentation of the research methodology and a short outline of considerations regarding reliability, replicability and validity, detailed information about the data collection methods and the data analysis is given in chapter 3. Consequently, the empirical findings of the study are presented in relation to the research questions and the theoretical background. Finally, a conclusion is drawn and managerial implications are discussed, before indicating research limitations and suggesting ideas and directions for future research.

1.4 The Industry Partner - Detecon

The industry partner of this research project is one of the world's leading consulting companies for ICT management consulting. Provided services focus on consulting and

the implementation of solutions which are derived from the use of information and communications technology (ICT). Detecon's portfolio comprises classic strategy and organization consulting as well as the planning and implementation of complex, technological ICT architectures and applications.

The company was founded in 1977, employs more than 1.200 associates around the world and has realized more than 20.000 projects for clients in over 165 countries. *Figure 2* gives an overview of Detecon offices worldwide. Detecon is a subsidiary of T-Systems International, the business customer brand of Deutsche Telekom.

Figure 2: Detecon offices worldwide (Company Presentation)

Due to their expertise in IT Strategy and a strong presence in the manufacturing industry, Detecon supported this research endeavor.

2 THEORETICAL BACKGROUND

In this chapter, a multidisciplinary theoretical background is presented that forms the basis of analysis for the following empirical study.

2.1 Literature Review Approach

In order to gain a comprehensive view on the analyzed concepts and for determining the conceptual grounding, a systematic literature review was carried out (Bryman and Bell 2011). Tranfield et al. (2003) define systematic review as *"a replicable, scientific and transparent process, in other words a detailed technology, that aims to minimize bias through exhaustive literature searches of published and unpublished studies and by providing an audit trail of the reviewer's decisions, procedures and conclusions"* (Tranfield et al. 2003, p.209). Servitization within the wider manufacturing context is a diverse and complex research field with several distinct research communities and concepts (Lightfoot et al. 2013; Baines et al. 2009). A categorization and introduction of the major research communities is given in *2.2.1 Related terms and research communities*. As a basis for the literature review, a search strategy was developed by identifying relevant keywords, time frame, and data sources. The databases EBSCOhost, Emerald Insight, ScienceDirect, Scopus, Web of Science, Wiley Online Library, as well as the search engine Google Scholar were searched using the keywords and combinations of the keywords shown in *table 1*.

Servitization	Servicizing	Servicification
Product service offering(s)	product-related service(s)	Dynamic Capability (ies)
Product service system(s)	Integrated solution(s)	Role of IT (Information Technology)
PSS	Integrated product service	Function of IT (Information Technology)
service-centered	Integrated product and service	Organization of IT (Information Technology)
service-oriented	service integration	Responsibility of IT (Information Technology)

Table 1: Literature search keywords

Above listed keywords were frequently combined with "manufacturing" in order to ensure their relevance to this study. Publications before the year 2000 were excluded.

Exceptions were made for key literature in the designated fields, such as Vandermerwe and Rada (1988) definition of servitization.

A large number of articles was found in the selected databases, which can be rationalized by the complexity of the research endeavor, interrelatedness of the research fields and the resulting variety of keywords. The different research fields or research communities addressing servitization will be explained later on in more detail. Discovered literature was filtered according to “times cited” and downloaded as far as a full-text version was available. First, duplications were detected and removed, second the abstracts were considered in order to choose appropriate literature. Initially the search identified around 250 articles, reports, and books. These could be carefully filtered to 104 articles and books that were considered for the research inquiry.

2.2 Servitization

The term Servitization was first defined by Vandermerwe and Rada (1988) and is widely recognized as the process of creating value through adding services to products (Baines et al. 2009). Since the late 1980s interest in the research field has grown rapidly, but the evolution of the concept can be traced back as far as the 1960s (Lightfoot et al. 2013). For the purpose of this study the view of Baines et al. (2009) on servitization as *"...the innovation of an organisations capabilities and processes to better create mutual value through a shift from selling product to selling Product-Service Systems."* (Baines et al. 2009, p.560) was adapted. Whereby the term “selling” might be misleading due to numerous new forms of distribution and payment systems.

The following literature analysis aims to provide a holistic view on servitization and to answer RQ1: Understanding Servitization: What are major drivers, forms, and challenges?

2.2.1 Related Terms and Research Communities

Existing literature on servitization is complex and diversified. There are five principal research communities engaging with servitization, each with a different focus and constitution (Lightfoot et al. 2013). A brief introduction of each community is given in order to enable an understanding of different ports of departure. The communities are

Services Marketing, Service Management, Operations Management, Product-Service Systems, and Service Science.

In the field of Services Marketing, research focuses primarily on a customer relationship management perspective of the service provision. A service dominant logic (SDL) has developed, which proposed that value is defined by and co-created with customers, rather than embedded in the output of goods (Lightfoot et al. 2013).

Deriving from operations and strategy domains, Service Management has a strong focus on service culture and service organizations, specifically in contrast to product-focused organizations (Lightfoot et al. 2013).

The broad field of Operations Management has expanded its scope with focus on operations management and strategy in the delivery of product and service combinations. Since the term servitization was first defined by Vandermerwe and Rada (1988), a growing number of publications are addressing the “servitization of manufacturing”. Competitive, service-led strategy for manufacturing is a growing area of interest (Baines et al. 2009; Lightfoot et al. 2013).

The Product-Service Systems (PSS) research community originated in Scandinavia, is closely connected to social, economic, environmental, and industrial sustainability. This can be explained by the focus on asset use rather than on asset ownership to achieve economic growth (Tukker 2004). Even though the research streams within the communities of operations management and PSS have largely evolved in isolation with only a few links made by researchers, there is a strong overlap in the concepts relating to servitization (Lightfoot et al. 2013; Baines et al. 2009; Baines et al. 2007; Tukker and Tischner 2006).

Service Science is the fifth community contributing to servitization. It is an interdisciplinary concept and has derived from the Information Systems (IS) sector and within IBM (Lightfoot et al. 2013). The concept emphasizes service as a system of interacting components which include people, business, and technology (Chesbrough and Spohrer 2006).

The difficulty of considering and combining literature from these diverse research communities is to critically reflect on their context and origin.

2.2.2 Drivers of Servitization

Providing services is not new for manufacturing firms. Traditionally, services were often seen by managers as a necessary evil for the sole purpose of marketing strategies. The largest share of total value creation came from physical goods and services were considered as an add-on (Gebauer and Friedli 2005).

Since then, there has been a dramatic change in perspective. The servitization literature commonly suggests three major driving forces that cause manufacturing firms to servitize (Baines et al. 2009).

Main financial drivers are a desired higher profit margin and stability of income. Service revenue is expected to be higher and more resistant to economic downturns. Especially in some sectors where manufacturers have a high-installed product bases (Gebauer and Friedli 2005; Oliva and Kallenberg 2003). According to Sawhney et al. (2004), firms, such as Siemens, GE, and IBM have achieved constant revenues from services despite a significant decrease in product sales. Strategic drivers are largely concerned with gaining competitive advantage in increasingly commoditized markets. Services are becoming a main differentiating factor and set barriers for competitors since integrated product and service offerings are more difficult to imitate. Higher labor dependency and lower visibility make competitive advantages achieved through services more sustainable (Mathieu 2001b; Gebauer and Fleisch 2007; Oliva and Kallenberg 2003; Lightfoot et al. 2013; Baines et al. 2009) Marketing drivers aim for selling more products based on the provision of services. The service component is well known to influence purchasing decisions. In particular in business-to-business markets, customers increasingly demand services to maintain own flexibility, focus on core competencies, and reduce technological complexity. Resulting advantages for suppliers are customer loyalty, repeat-sales, and maybe most importantly, contact opportunities with customers, which allow to offer other products or services and tailor solutions based on customers' needs (Gebauer and Fleisch 2007; Oliva and Kallenberg 2003; Vandermerwe and Rada 1988; Mathieu 2001a, 2001b).

2.2.3 Forms of Servitization

Customer centricity is a key feature of servitization strategies. Oliva and Kallenberg (2003) consider customer focus as consisting of two elements. First, the shift from product-oriented offerings to the integration of user's processes, and second the shift from transaction-based to relationship-based customer interactions. A variety of servitization forms with differing features have been identified by the literature along this "product-service continuum" (Oliva and Kallenberg 2003; Neu and Brown 2005; Gebauer et al. 2007). The continuum ranges from product orientation where services are offered purely as add-ons to products, to results orientation where services create the main part of value with tangible goods as add-ons (Baines et al. 2009; Tukker 2004).

Neely (2008) holds a similar view and differentiates between five forms of servitization along the discussed continuum: Integration oriented PSS, product oriented PSS, service oriented PSS, use oriented PSS and result oriented PSS. The forms of servitization are described in *table 2* and visualized in *figure 3*.

Integration oriented PSS	Ownership of the tangible product is transferred to the customer, but the supplier seeks vertical integration, for example by moving into retail and distribution, financial services, consulting services, property and real estate services, or transportation and trucking services.
Product oriented PSS	Ownership of the tangible product is transferred to the customer, but additional services directly related to the product are provided, e.g. design and development services, installation and implementation services, maintenance and support services, consulting services, outsourcing and operating services, procurement services.
Service oriented PSS	Services are incorporated into the product itself. Ownership of the tangible product is still transferred to the customer, but additional value added services are offered as an integral part of the offering, e.g. health usage monitoring systems and intelligence vehicle health management. This is the first option which involves a coupled product and service, as opposed to product plus service.
Use oriented PSS	Focus is shifting towards the service (which is delivered through a product). Often ownership of the tangible product is retained by the service provider, who sells the functions of the product via modified distribution and payment systems, such as sharing, pooling, and leasing.

Result oriented PSS	The Service seeks to replace the product, thereby doing away with the need for the product, or certainly an individually owned product. A classic example would be voicemail services where the service itself replaces the need for individuals to own their own answering machines.

Table 2: Five forms of servitization, according to (Neely 2008)

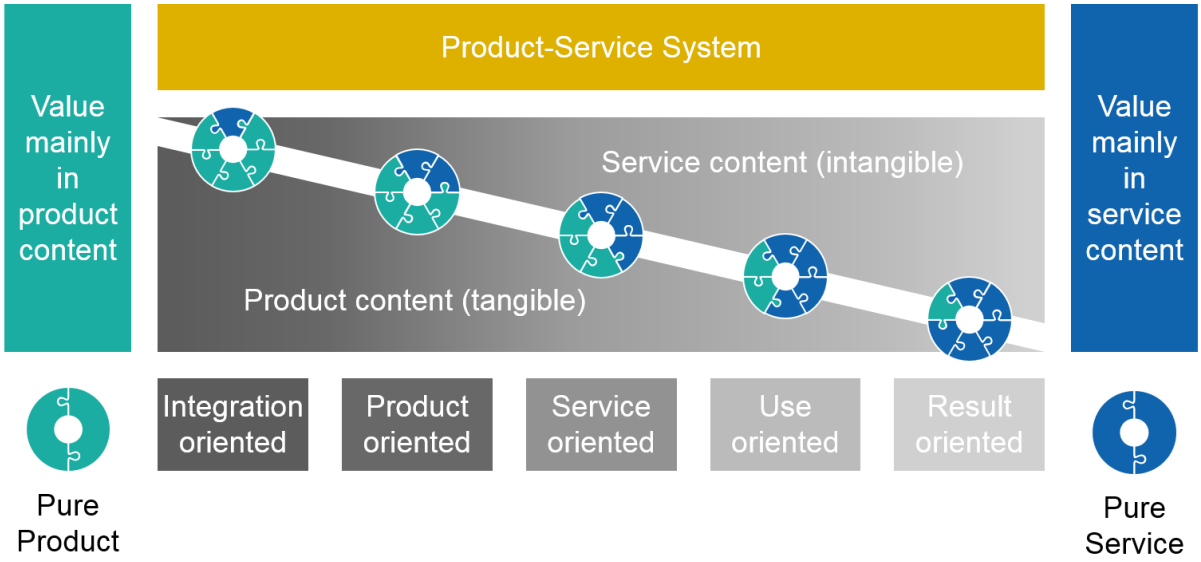

Figure 3: Forms of servitization, according to (Tukker 2004; Neely 2008)

The importance of IT for servitization is particularly explicit when products and services are incorporated as described for service oriented PSS. More and more business models arise within the manufacturing sector where the value proposition is mainly based on services as the fundamental value creating activity, reducing products to become the minor part of the offering (Oliva and Kallenberg 2003; Vandermerwe and Rada 1988).

2.2.4 Challenges in Moving into Services

Manufacturing firms face several challenges when pursuing a servitization strategy (Baines et al. 2009). Products and services have a significantly different design process. Service design is often difficult to define, fuzzy, and a special focus needs to be put on describing and communicating the value proposition to customers. In this context Gustafsson and Brax (2005) emphasize the importance of integrative information technologies and information management practices for the development and delivery of complex services. Moreover there is a risk of unexpected rivalry with suppliers, distributors, and customers, when competition from outside the former value

chain position is not taken into consideration (Vandermerwe and Rada 1988; Oliva and Kallenberg 2003; Mathieu 2001b). It is not sufficient to merely define a service-oriented strategy. Organizational structures, processes, and capabilities have to be shaped accordingly to carry out the strategy. This means implementing service orientation and customer-centricity for the development, as well as the delivery of services. In this context, partnering with suppliers and customers becomes increasingly important (Windahl et al. 2004; Oliva and Kallenberg 2003; Leseure et al. 2010). Mathieu (2001b) highlights that service management often conflicts with traditional manufacturing practices, for instance due to the difference in organizational culture. Hence, a shift in the corporate mindset is necessary to acknowledge and prioritize the importance of services. The approval of needed resources and management support will require significant changes to established attitudes and practices (Mathieu 2001b; Oliva and Kallenberg 2003). In *figure 4*, the servitization challenges are summarized according to (Leseure et al. 2010).

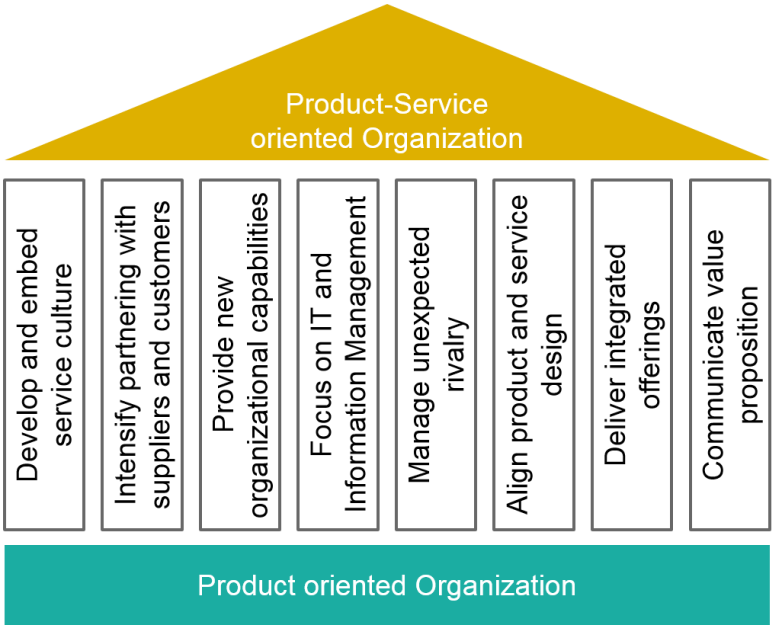

Figure 4: Architecture of challenges, according to (Leseure et al. 2010)

This study discusses and addresses the challenges from the perspective of organizational capabilities and the strategic role of the IT organization. Nevertheless, as the building like structure suggests, the strategic objective of moving into services should be treated as a holistic approach, affecting the whole organization and necessitating changes throughout the business model (Kindström, Kowalkowski 2014; Teece 2007).

2.2.5 The Service Paradox

The service paradox as discovered by Gebauer et al. (2005), describes the difficulty of manufacturers to exploit the financial potential of an extended service business. Manufacturing firms trapped in the service paradox substantially invest in the service business, which leads to higher costs and increased offerings, but does not yield the expected higher return on services (Gebauer et al. 2005). The service paradox is visualized in *figure 5*, where transition line 1 represents manufacturing companies successfully transforming into service providers and exploiting the financial potential of an extended service business, while transition line 2 represents those companies failing to exploit the financial potential (Gebauer et al. 2005). Neely (2008) examined the effect of firm size and the extent of servitization on net profit as a % of sales revenue and discovered, that merely larger firms have difficulties to achieve financial benefits through servitization. He indicates, the "service paradox" would mainly result from companies disregarding the above mentioned challenges, struggling with their successful implementation or from cognitive phenomena limiting managerial motivation to extend the service business (Neely 2008).

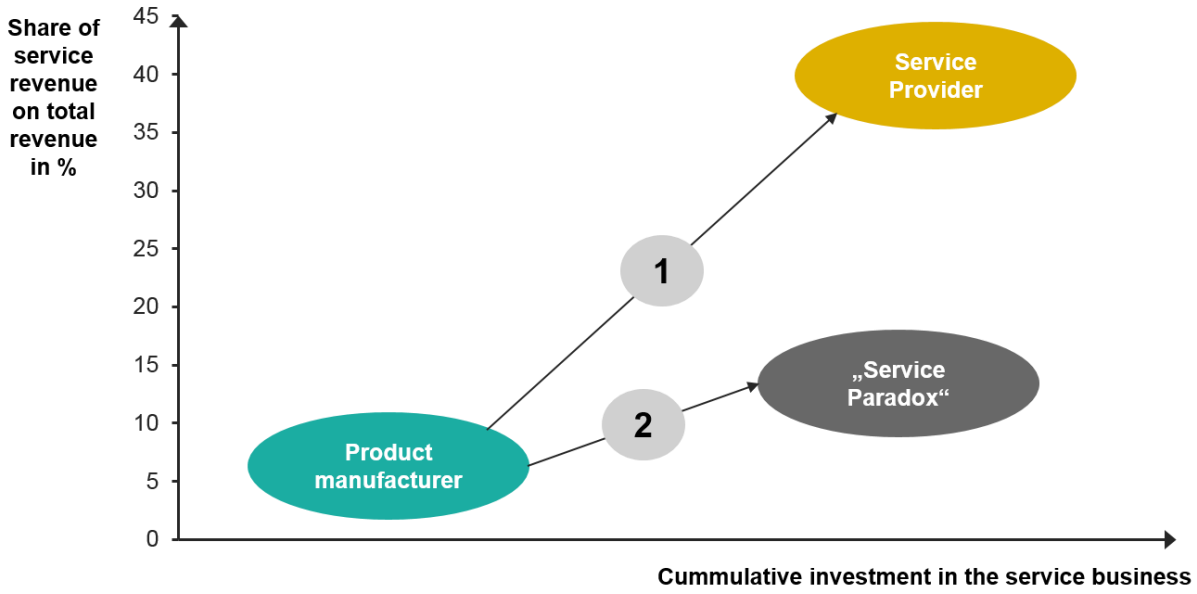

Figure 5: The service paradox (Gebauer et al. 2005)

2.2.6 Measuring Servitization

For measuring the current and expected future degree and importance of servitization in the surveyed manufacturing firms, five questions are compiled. They aim to assess

the current, as well as future importance of PSS for the firm, as well as the current and future service orientation in policies, practices and procedures. Moreover, respondents were asked to estimate the share of their firm's total revenues currently generated through services. The survey questions and related references are listed in *table 3*.

Survey Question	**Reference**
How important are integrated product-service offerings currently for your enterprise?	(Brashear Alejandro et al. 2013); (Lytle et al. 1998)
How important will integrated product-service offerings become for your enterprise in the future?	(Brashear Alejandro et al. 2013); (Lytle et al. 1998)
How important is service orientation in your enterprise's current policies, practices and procedures?	(Brashear Alejandro et al. 2013); (Lytle et al. 1998)
How important will service orientation become for your enterprise in the future?	(Brashear Alejandro et al. 2013); (Lytle et al. 1998)
Which share of your enterprise's total revenue is currently created through services?	(Gebauer and Friedli 2005); (Gebauer et al. 2005)

Table 3: Survey questions for measuring servitization

2.2.7 The Process of Servitization

Baines et al. (2007) suggest that *"the innovation of a manufacturing organization's capabilities and processes to shift from selling product to selling an integrated product and service offering that delivers value in use"* can be considered as the process of servitization.

As touched upon in *2.2.4 Challenges when Moving into Services*, manufacturers need new capabilities that facilitate change in order to achieve a successful transition from products towards PSS. These capabilities can either be developed internally or externally. In fact, the decision is similar to the "make or buy" question (Davies 2004). Surprisingly, a major share of the literature dealing with the transition does not touch upon the sourcing decision for developing and delivering PSS (Paiola et al. 2013; Gebauer et al. 2005). Mathieu (2001b) refers to the capability sourcing as a continuum between internal development, partnering and outsourcing. The internal development of capabilities has the advantage for firms to keep control of all services and products which are part of the solution. This is seen as beneficial for the integration of all components due to less coordination efforts across organizational boundaries (Nordin 2008). On the contrary, it might become more difficult for companies to specialize in

particular capabilities due to the increased number of capabilities. Moreover costs might be higher compared to external sourcing from the market. Advantages of external capability development are timeliness and lower fixed costs (Neely 2008). Nevertheless the risk of losing control over the service component, the risk of competitive behavior by business partners, and the high integration costs should not be neglected (Paiola et al. 2013).

A major challenge with the shift from products to PSS is the management of capabilities that are seen as essential for organizational change in general, and service innovation in particular (Kindström et al. 2013; Teece 2007). In order to understand these specific capabilities, the dynamic capability framework is introduced in the following.

2.3 Dynamic Capability Framework

Dynamic capabilities are widely seen as a key to competitive advantage and superior enterprise performance in rapidly changing and strongly competitive environments (Teece 2007; Teece et al. 1997; Winter 2003). Recently published literature increasingly focuses on dynamic capabilities as enabler for servitization (Kindström et al. 2013; Gustafsson et al. 2010; den Hertog et al. 2010) and as key to business architecture leading to alignment between business and IT (Ross et al. 2014).

Dynamic Capabilities are a "*firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments*" (Teece et al. 1997, p. 516).

According to Teece (2007), dynamic capabilities are especially relevant to multinational enterprises operating in business environments with the following characteristics:

- An environment open to international trade and exposed to rapid technological change.
- Technical change taking place as a complex process, presuming the combination of multiple inventions to create products and services.
- The existence of well-developed markets for the exchange of services and goods.

- Poorly developed markets for the exchange of technological and managerial know-how.

These characteristics can be found in most sectors of the global economy and in particular in the capital goods and high-technology sector. In these sectors, Teece (2007) argues, it is not sufficient to focus on process optimization and scale economics for sustainable success, but rather on the continuous discovery and realization of internal and external opportunities.

2.3.1 The Evolution of Dynamic Capabilities

The dynamic capability framework (DCF) *"is grounded in Kirznerian, Schumpeterian, and evolutionary theories of economic change…"* (Teece 2007, p. 1325) and builds strongly on the resource-based view (RBV) of the firm (Grant 2010).

With the rise of the RBV and the DCF in the 1990s, the focus of analysis in strategic management literature shifted from the firm's position in its external environment, as provided by porter's five forces, towards the role played by the internal organization of the firm (Teece 2007; den Hertog et al. 2010; Grant 2010). In the RBV, a resource is defined as *"...an asset or input to production (tangible or intangible) that an organization owns, controls, or has access to on a semi-permanent basis"* (Helfat, Peteraf 2003, p. 999). The DCF in contrast, views organizational capabilities as a complex combination of various resources that express "what a firm can do" (Grant 2010). The major difference between the DCF and the RBV is that the DCF considers the evolutionary nature of resources and capabilities, while the RBV represents a rather static perspective (Gustafsson et al. 2010; Teece et al. 1997). According to Helfat et al. (2009), dynamic capabilities incorporate the capacity to identify the need or opportunity for change, formulate a response, and implement a course of action.

2.3.2 Capability Building

Capabilities are a coordinated set of tasks that require the integration of actions performed by various individuals and organizational resources. In order to transform into organizational capabilities, capabilities need to be routinized through firm specific managerial and organizational processes (Grant 2010; den Hertog et al. 2010). Routinization is seen as an essential step since regular and predictable patterns of

activity lead to efficiency and reliability. Moreover, evolutionary economists view the adaptation and replication of organizational routines as fundamental building blocks for a firm's development and for managing the trade-off between efficiency and flexibility (Grant 2010).

Figure 6 shows the described building of organizational capabilities based on two levels. On the resource level, internal as well as external resources that are key ingredients to the capability building are identified. Thereafter, the organizational level mobilizes and deploys these resources via organizational structures, processes and roles (Peppard and Ward 2004; den Hertog et al. 2010).

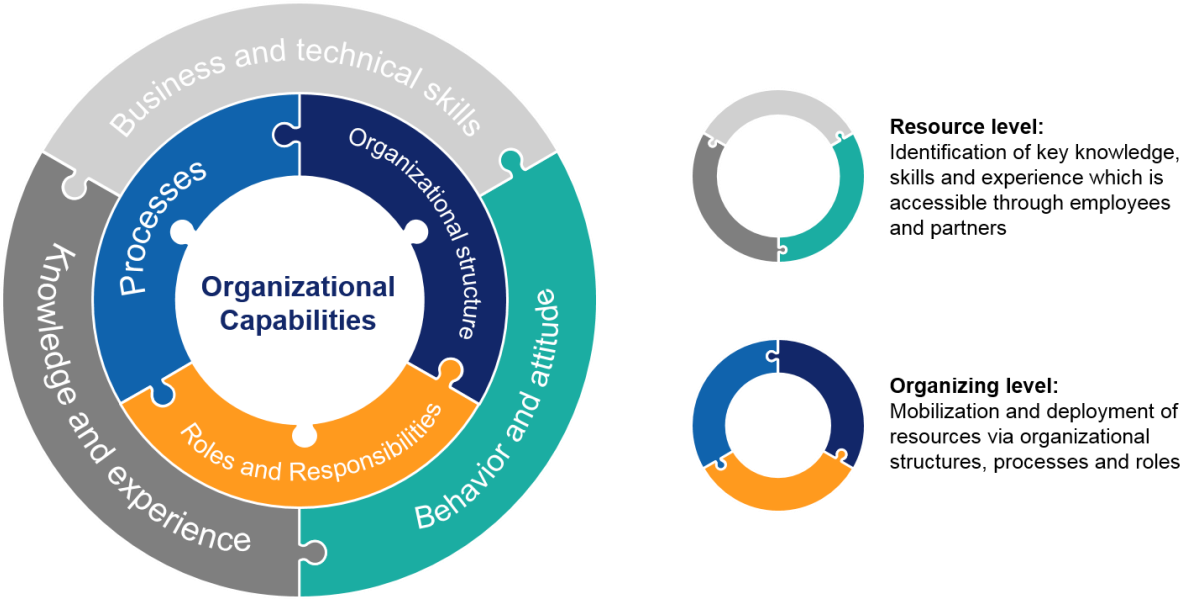

Figure 6: Organizational capability building, based on (Peppard and Ward 2004)

According to Sambamurthy et al. (2003), IT and business resources are integrated into organizational capabilities through what they call the "capability-building process". Furthermore they emphasize that the development of capabilities is based on strategic decisions about investments in IT that are aligned with business strategy and processes and takes place over time (Sambamurthy et al. 2003).

2.3.3 Operational Capabilities

In order to distinguish operational from dynamic capabilities, operational capabilities can be defined as *"a coordinated set of tasks performed by various individuals and utilizing organizational resources to achieve a particular end result"* (Helfat, Peteraf

2003, p. 999). In other words, operational capabilities ensure a stable base of ongoing operations for an organization in order to “earn a living at present” (Winter 2003; Teece 2007). While dynamic capabilities, by contrast, do not directly contribute to the output of a firm, but give direction to operational capabilities (den Hertog et al. 2010; Helfat, Peteraf 2003).

2.3.4 Dynamic Capabilities

In order to inquire dynamic capabilities, a process was developed for designing single statements (indicators) that represent a specific category of dynamic capabilities. The aim was to understand and differentiate between dynamic capabilities and enable their measurement in the surveyed firms. Thereby RQ2: What are dynamic capabilities and how can they support servitization?” can be addressed.

Initially, literature focusing on dynamic capabilities was screened for existing dynamic capabilities. In doing so, attention was paid to separate dynamic capabilities from other capability concepts which were not considered. As a next step, the discovered dynamic capabilities were gathered using a comprehensive spreadsheet. In a third step, redundancies were eliminated and the content was classified following Teece (2007) division into Sensing, Seizing, and Reconfiguring capabilities.

Table 4 lists literature considered in the process of compiling the statements.

(Kindström et al. 2013)	(den Hertog et al. 2010)
(Kindström, Kowalkowski 2014)	(Weill, Vitale 2002)
(Teece 2007)	(Gustafsson et al. 2010)
(Sambamurthy et al. 2003)	(Akershoek 2016)
(Schuh et al. 2015)	(Westermann et al. 2006)
(Street 2007)	(Windahl et al. 2004)
(Fink, Neumann 2007)	(Nylén, Holmström 2015)
(Helfat et al. 2009)	(Ross et al. 2014)
(Parida et al. 2015)	(Story et al. 2016)
(Winter 2003)	(Peppard and Ward 2004)

Table 4: Literature for dynamic capability indicators

The three categories of dynamic capabilities, together with the compiled indicators are introduced in the following.

2.3.4.1 Sensing Capabilities

Sensing capabilities detect and shape new technological and market opportunities but also potential threats. Activities involved are especially scanning, filtering, learning, and interpreting (Teece 2007; den Hertog et al. 2010; Kindström et al. 2013).

Therefore this study compiled that firms need the following characteristics (indicators) in order to successfully employ dynamic sensing capabilities:

- Continuously capture customer needs and identify target market segments.
- Exploit supplier and complementary innovation.
- Identify threats and opportunities in the extended value chain and such related to competitors' behavior.
- Explore new technologies and developments in exogenous science.
- Direct internal R&D and select technologies based on above listed sensing activities.

2.3.4.2 Seizing Capabilities

Seizing capabilities address technological and market opportunities through new services (Teece 2007). Solely investing into technology is therefore not enough, an environment has to exist that is capable of sheltering and exploiting new opportunities as they emerge (Chesbrough 2010; Teece 2010). Organizational designs, structures, procedures, and incentives need to be shaped to overcome biased judgements that favor path-dependent decisions and bury opportunities (Teece 2007).

For the successful employment of dynamic seizing capabilities, firms need the following characteristics (indicators):

- Describe the customer solution and the corresponding business model in detail.
- Identify connections between existing capabilities and requirements of emerging opportunities.
- Experiment with new service opportunities through close interaction with customers.
- Implement decision making protocols to avoid decision errors and tendencies for anti-cannibalization.
- Select enterprise boundaries to manage complements and to control platforms.

- Integrate whole business processes of the customer.

2.3.4.3 Reconfiguring Capabilities

The third category, reconfiguring capabilities, match and manage the dependence between service strategy and organizational design in order to achieve strategic alignment (Teece 2007). According to Gustafsson et al. (2010), despite numerous literature on organizational factors for servitization, literature rarely gives guidance on how to achieve strategic alignment. Strategic alignment is seen as a complex process demanding ongoing assessment and realignment (Kindström 2010; Helfat et al. 2009).

To successfully employ dynamic reconfiguring capabilities, firms need the following characteristics (indicators):

- Adopt loosely coupled structures and develop integration and coordination skills.
- Achieve incentive alignment and avoid agency issues.
- Manage co-specialization so that asset combinations are value enhancing.
- Build loyalty and commitment to services.
- Establish knowledge management to transfer and integrate know-how.
- Scale up successful service innovations based on standardization and consolidation.
- Create a consistent service experience for customers, independent from the location and involved partners.

2.4 The Role of IT for Servitization

As introduced in the previous chapters Information technology (IT) is a key enabler for servitization in manufacturing firms (Brashear Alejandro et al. 2013) and essential for the building of organizational capabilities (Sambamurthy et al. 2003). One could reason that *"the service revolution and the information revolution are two sides of the same coin"* (Rust 2004, p. 24). Or as Huang and Rust (2013) put is: *"Service is not new; it is service plus IT that transforms service."* (Huang and Rust 2013, p. 251). IT enables deeper customer relationships and insights, as well as the provision of complex service offerings, such as service-oriented, use-oriented, and results-oriented PSS (Penttinen and Palmer 2007). Examples of IT-enabled services are new service-oriented PSS

which depend on the collection, processing, and evaluation of real-time information about the condition and utilization of the installed base (Kowalkowski, Brehmer 2008). In order to measure the importance of the IT organization for the development and for the delivery of PSS, the following questions were included in the survey *(table 5)*.

Survey Question	Source
How important is the IT department currently for developing integrated product-service offerings?	(Huang and Rust 2013); (Gerick 2014); (Sambamurthy et al. 2003); (Belvedere et al. 2013)
How important is the IT department currently for delivering integrated product-service offerings?	(Huang and Rust 2013); (Gerick 2014); (Sambamurthy et al. 2003); (Belvedere et al. 2013)

Table 5: PSS development and delivery

The strategic role of IT, embodied by the IT organization, has a decisive influence on the relevance and impact IT plays in a firm. Prior studies have hardly focused on the role of the IT organization as an enabler for servitization. Noteworthy exceptions are Brashear Alejandro et al. (2013) investigation in how ICT can enable service differentiation and in doing so act as a catalyst for service business orientation, and Song et al. (2015) special section on the role of information technology.

For the purpose of addressing RQ3: Which strategic role should the IT organization play to enable servitization? , this study classifies IT along the three roles Innovation Enabler, Solution Integrator and Efficient Operator. The three in the following sections developed roles of IT are characterized by five components: A vision and mission, the governance responsibility regarding technology and service innovation projects and delivery, the degree of centralization regarding IT portfolio decision, as well as the cost structure. The roles should be seen as a continuum rather than as sovereign entities.

2.4.1 Vision of IT

Zimmermann (2013) recommends that the vision and mission of IT should be compiled based on organizational requirements, which derive from a detailed analysis of business objectives, technological and market trends, the external environment, as well as single department needs.

An organizations vision or vision statement generally expresses what an organization wants to become (Grant 2010). For the purpose of practical implication and to simplify comprehension, the vision indicators were formulated as actions. Ramiller and Swanson (2003) observe that from a practitioners perspective *"…organizing visions are important in shaping thinking about the opportunities (and threats) that may lie ahead, in establishing expectations concerning what constitutes effective, proper, and up-to-date practice, and in motivating the action that will help to create the future of IT application and practice."* (Ramiller and Swanson 2003, p. 15)

The mission on the other hand defines the purpose of an organization and identifies the scope to set it apart from other organizations (Pearce II, David 1987).

The characteristics of the three in the following described roles of IT are based on Peterson (2004a); Peterson (2004b); Guillemette and Paré (2012); Sambamurthy et al. (2003); Sia et al. (2010); Gottschalk (2004); Gerick (2014); Ross et al. (2010); and Ross et al. (2011).

When the IT organization embodies the role as an Innovation Enabler, IT is impact oriented, seeks to deliver value through innovative solutions and drives first mover advantage. IT as a Solution Integrator is integration oriented and defines new capabilities together with business to meet time-to-market requirements. Delivery of leading edge solutions that support new offerings takes place either through internal development, external contracting or packaged software. The third role of IT as Efficient Operator is infrastructure oriented and focused on providing IT operations and solutions with a maximum of reliability and availability. IT meets standard business requirements and manages cross-unit synergies across the organization.

The following *table 6* summarizes each IT role's vision as stated in the questionnaire.

Innovation Enabler	IT drives first mover advantage through innovative solutions.
	IT tailors offerings that outperform business demands.
Solution Integrator	IT continuously enhances business operations with leading-edge solutions.
	IT defines future requirements together with business.

	IT integrates solution partners to meet future requirements.
Efficient Operator	IT operations and solutions are provided with a maximum of availability and reliability.
	IT infrastructure is established to manage cross-unit synergies across the firm and to ensure a maximum of cost-effectiveness.

Table 6: Vision of IT

2.4.2 Mission of IT

IT as Innovation Enabler provides a platform that puts focus on agility, innovation, and speed to market. In order to enable an innovation ecosystem that pools internal knowledge and expertise, IT needs to invest in experimentation and applies, as well as shares best practices enterprise-wide. Therefore, the IT infrastructure needs to be adaptive and facilitate agile sourcing. IT as Solution Integrator provides a platform for integrating solution partners to ensure the timely delivery of solutions. In order to achieve business responsiveness, proximity to business, as well as to IT-decision-making needs to be assured. For the purpose of successful integration, attention should be directed on constructive negotiation and the facilitation of conflict resolution. Taking the role as Efficient Operator, IT provides a platform that aims to maximize standardization, and drives scale through sourcing, consolidation, process improvement, as well as service quality across the organization.

The following *table 7* summarizes each IT role's mission as stated in the questionnaire.

Innovation Enabler	IT provides an agile platform that allows rapid reconfiguration to create innovative IT-enabled business capabilities.
Solution Integrator	IT provides a platform that allows the integration of solution partners to enable the timely development and delivery of capabilities to support new offerings.
Efficient Operator	IT provides a platform that allows leveraging cross-unit synergies across the firm for example through shared services.

Table 7: Mission of IT

2.4.3 IT Governance and Degree of Centralization

The IT governance determines the distribution of IT responsibilities and strategic decision-making rights within the organization and defines rules and mechanisms for monitoring decisions (Peterson 2004a). In other words, governance answers the

questions who makes IT decision and how, rather than which decisions are made (Weill 2004). Since an organization's IT portfolio is directed by the governance, it is considered *"the single most important determinant of IT value realization"* (Peterson 2004b, p. 37).

In the survey, the inquiry of IT governance is segmented into two parts. The first set of statements examines the IT organization's responsibility for technology and service innovation, whereas the second set of statements looks into the degree of geographical and managerial diffusion of decision making rights.

IT as Innovation Enabler is responsible for technology and service innovation delivery, and any projects initiated. Here, IT is to a large extent directly responsible for the firm's competitiveness. The Solution Integrator role embodies shared responsibility between business and IT for technology and service innovation delivery and projects. Acting as Efficient Operator, IT is responsible for the availability of Information Systems and Services, but has no own responsibility for technology and service innovation delivery and projects.

The following *table 8* summarizes each IT role's responsibility for technology and service innovations as stated in the questionnaire.

Innovation Enabler	IT has responsibility for technology and service innovation delivery and any projects initiated and is therefore to a large extent responsible for the firm's competitiveness.
Solution Integrator	Business and IT have joint responsibility for technology and service innovation delivery and projects.
Efficient Operator	IT has no own responsibility for technology and service innovation delivery and projects, but for the availability of Information systems and services.

Table 8: IT Governance

The degree of IT governance centralization describes the managerial and geographical allocation of IT control and decision-making authority with regards to different IT functions (Peterson 2004a). While traditionally IT was seen as a single homogenous function, this notion is becoming increasingly obsolete due to the expansion and infusion of ICT in organizations (Peterson 2004b). Weill and Broadbent (1998) argue that modern organizations consist of a portfolio of interdependent functions and

capabilities and visualize the different IT functions in a simplified IT portfolio as adapted in *figure 7*. Moreover, IT governance has to address the dual demands of maintaining present business operations, while designing the IT function to meet future business demands (Peterson 2004a).

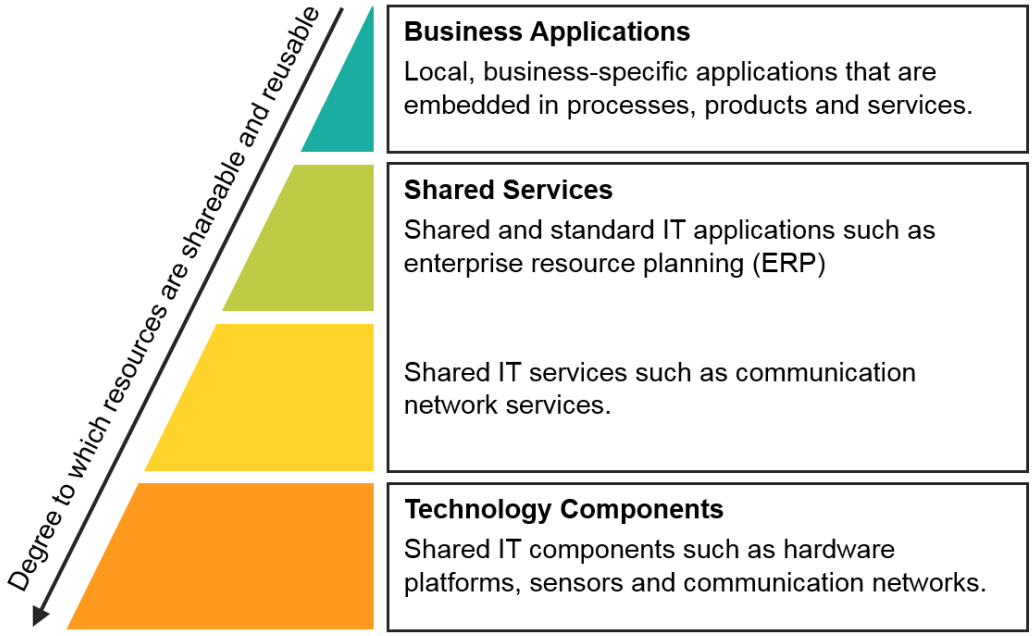

Figure 7: IT Portfolio, adapted from (Weill and Broadbent 1998; Peterson 2004b)

Following the proposition by Peterson (2004b); Weill and Broadbent (1998); and Peterson (2004a), the simplified IT Portfolio is divided into the functions Business Applications, Shared Services and Technology Components.

Business Applications are local, business-specific applications that are embedded in processes, products and services. Nevertheless, these applications utilize shared services and are built on shared platforms. Governance needs to decide upon prioritization and planning, budgeting, as well as delivery and maintenance of Business Applications. Shared Services are shared and standard IT applications such as enterprise resource planning (ERP) and shared IT services such as communication network services, which are based on knowledge of business processes and functions. Technology Components are shared IT components such as hardware platforms, sensors and networks, that require standards for procurement and deployment of IT resources (Peterson 2004a; Peterson 2004b; Weill and Broadbent 1998).

To each of the three functions the dichotomy of centralization and decentralization can be applied. In general, centralization leads to greater standardization, specialization and economies of scale, while decentralization on the other hand enables a greater agility and responsiveness to specific business needs or *"as noted in Teece et al. (1997), more decentralized organizations with greater local autonomy are less likely to be blindsided by market and technological developments." (*Teece *2007, p. 1323)*. According to Mintzberg (1979), centralization and decentralization should be treated as two ends of a continuum. In order to balance the benefits and disadvantages of both, a federal, hybrid governance model is proposed by several authors. Within the federal IT governance model, Technology Component decisions are centralized and Business Application decisions are decentralized (Peterson 2004a; Peterson 2004b; Weill and Broadbent 1998). Advantages as well as disadvantages of the different IT governance models are summarized in *table 9*. Peterson (2004b) mentions well-known companies from different industries that have been actively experimenting with a federal IT governance model.

	Centralized IT Governance	Decentralized IT Governance	Federal IT Governance
IT synergy	**+**	**-**	**+**
IT standardization	**+**	**-**	**+**
IT specialization	**+**	**-**	**+**
Business responsiveness	**-**	**+**	**+**
Business ownership	**-**	**+**	**+**
Business flexibility	**-**	**+**	**+**

Table 9: Advantages and disadvantages of IT Governance models (Brown, Magill 1998; Rockart et al. 1996)

Within the federal IT governance model, different patterns of differentiation exist (as shown in *figure 8*), ranging from IT-centric, balanced between business and IT, to business-centric. In an IT-centric federal model, the divisional IT Management (e.g. Division Information Officer) is responsible for Business Application and Shared Service decisions, and the corporate IT executive is responsible for Technology Component decisions. While in a business-centric federal model, divisional business executives take the lead in Business Application and Shared Service decisions and corporate IT executives are still responsible for Technology Component decisions. A federal model which aims to balance Business and IT responsibility for Business Applications and Shared Services, necessitates increasing coordination between

divisional Business and IT decision makers, and as a result carries the risk to suffer from a loss of agility (Westermann et al. 2006).

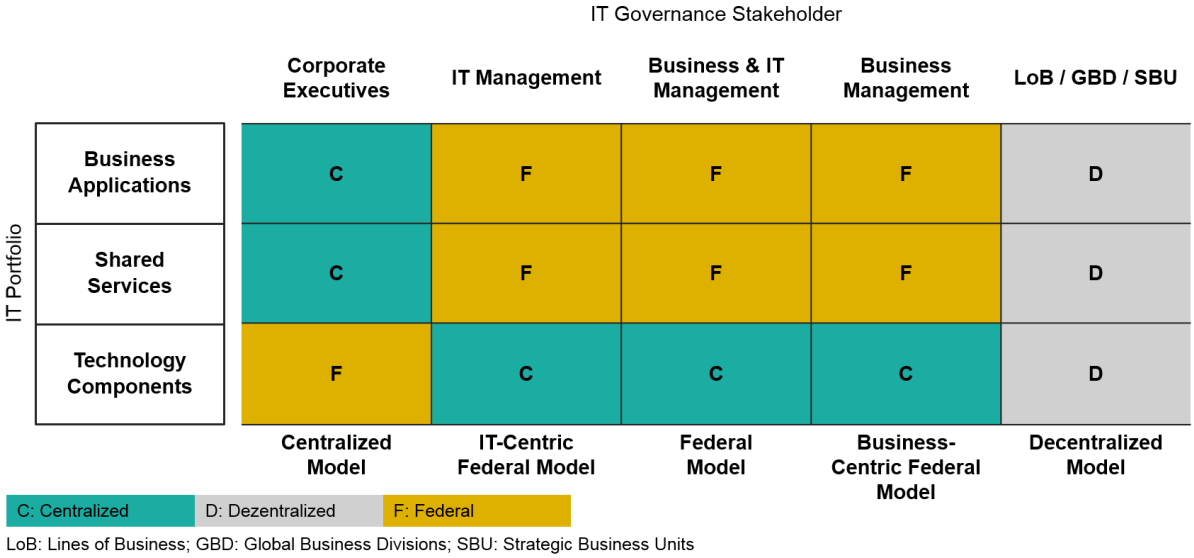

Figure 8: IT Governance - Degree of centralization, adapted form (Peterson 2004a)

In the context of this study, the interest lies especially on the IT governance model for Business Application decisions, since Business Applications are seen as crucial for offering advanced PSS. The following survey statements were constructed to measure the IT governance model for IT portfolio decisions.

T*able 10* summarizes the degree of IT governance centralization as stated in the questionnaire.

Innovation Enabler	IT is decentralized. Several IT departments bring IT geographically closer to the user.
Solution Integrator	IT is federalized. IT is diffused regarding geography and management
Efficient Operator	IT is centralized. One central IT department provides services with a single-access provision.

Table 10: Degree of centralization

2.4.4 IT Controlling - Cost structure of IT

In particular within German literature, the task of managing costs and performance of IT is referred to as “IT controlling” (Hamel et al. 2010). Gadatsch (2009) gives an overview of IT controlling concepts and central tasks. The tasks reach from evaluating the value contribution of IT, supporting IT strategy and portfolio development, product

and project controlling, IT cost and performance accounting, to operational controlling (Gadatsch 2009). According to Strecker and Kargl (2009), the research field of IT controlling suffers from a lack of integration, which is expressed through missing synchronization between research on IT controlling methods and developments in practice on one hand, and missing synchronization between IT controlling methods and methods of business and information systems engineering (BISE) on the other hand.

In 2010, worldwide IT expenditures reached approximately 1.48 trillion US Dollar and IT budgets represented amounts between 3% and 15% of firm's revenues, depending on the business sector (IDC 2010). This magnitude explains why IT management faces increasing pressure to track the value contribution of IT investments (Hamel et al. 2010). Plannability based on cost transparency and the accountable allocation to the business are crucial for successful IT Management. IT controlling should therefore support the interaction and coordination of interests between business and IT, through enabling high controllability of IT resources and demonstrating the business value which is added through IT activities. Zimmermann (2013) argue that the identification of core capabilities and competencies of IT is crucial for cost allocation and transparency. Nevertheless, it has to be mentioned that the evaluation of IT investments and resulting value contribution is challenging due to the usually intangible and complex characteristics of IT services.

Following Gadatsch, Mayer (2010), IT controlling can be divided into strategic IT controlling and operational IT controlling along an IT process model consisting of three parts *(Figure 9)*. The IT process model includes selected IT management tasks and draws no clear line in the transition from strategic to operational IT controlling (Gadatsch 2009).

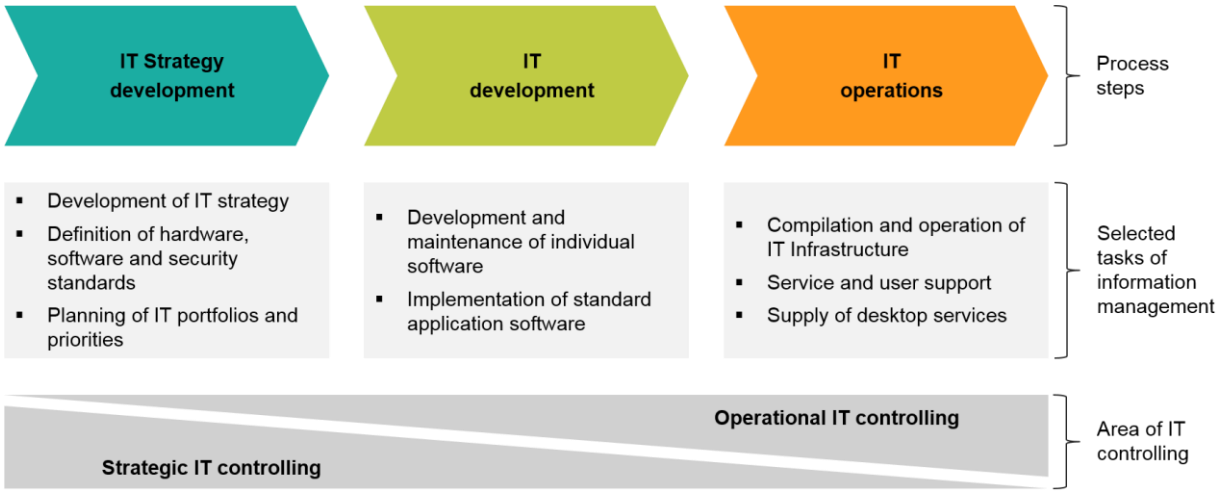

Figure 9: Areas of IT controlling along the IT process model (Gadatsch 2009; Gadatsch, Mayer 2010)

In the first process step, IT controlling works together with IT management and business departments to align IT and business strategy and to ensure that the IT portfolio is compatible with the IT strategy. Within the IT development process step, IT controlling supports the compliance of targets, results and budgeting of IT projects. Efficiency analysis should be carried out for projects, and outsourcing of software development should be evaluated by IT controlling. In the third process step, IT controlling supports planning and operation of the IT landscape, which covers all information systems, services and hardware (Gadatsch 2009).

IS literature often states the interdependency and consequent conflict between IT development (build function) and IT operations (run function). The build and run functions are interdependent since the quality and architectural consistency during the development phase largely effect operating costs. Increasing operating costs on the other hand often reduce budget available for development projects. Studies conducted by the MIT Center for Information Systems Research (CISR) found that firms spend on average 66-68% of their IT budgets on IT operations (Ross et al. 2010).

Due to the increasing penetration of business processes with IT and the rising share of IT costs relative to the total costs of an enterprise, IT controlling is often falsely identified with IT cost management. A performance oriented IT controlling approach on the contrary is expected to facilitate the competitiveness of an enterprise by improving processes and efficiency of the use of IT (Gadatsch 2009).

According to Ross et al. (2010), the value proposition of IT will change significantly from business support and solution delivery towards business process design and revenue generation. As shown in *figure 10*, 88% of the surveyed IT executives indicated that the value proposition of IT will change in the next 3-5 years. Even though the shift in the value proposition has appeared not as extreme as expected by the study, a clear tendency can be observed (Ross et al. 2010). The new value proposition of IT as a revenue generator rather than business support imposes significantly different requirements on controlling of IT. This trend will certainly not stop at the organizational boundaries of manufacturing firms.

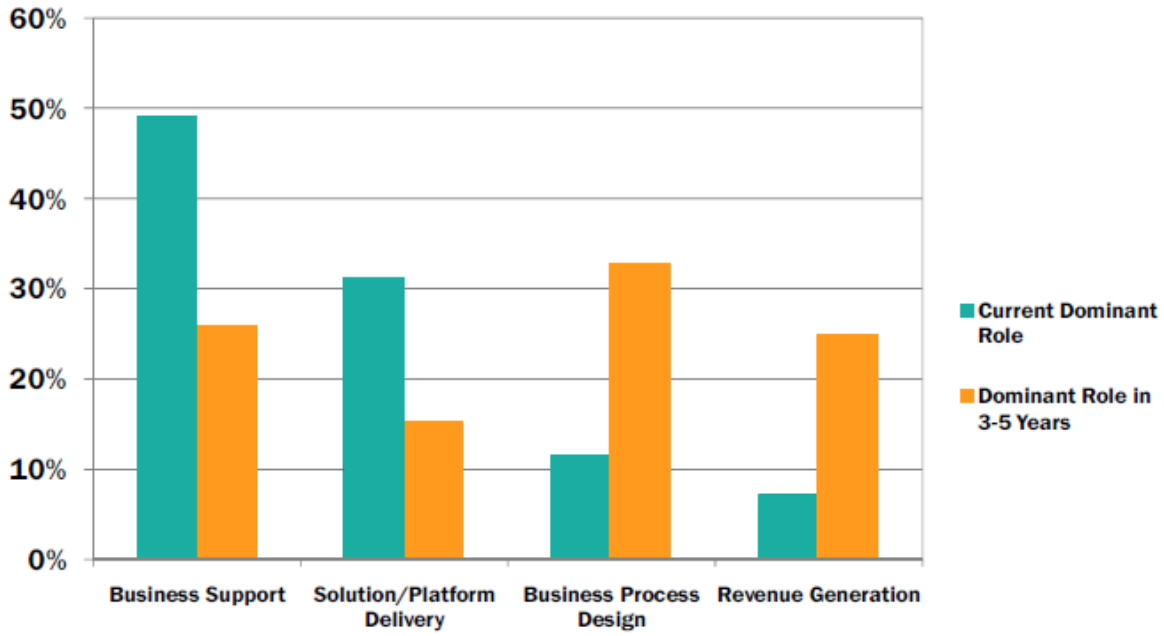

Figure 10: IT's value proposition (Ross et al. 2010)

The center concept allows a performance oriented controlling by dividing an organization in autonomous units (center) with differing market orientation, following the centralization versus decentralization debate. These autonomous units provide services to internal and external customers with different performance, responsibility accounting and basis of assessment. In order to simplify further analysis, the IT organization is considered as one autonomous unit, even though it could be divided into several units with again differing cost structures. Following the center concepts logic, the cost structure of IT discriminates between cost-center (also called expense center), revenue center, profit center and investment center (Dillerup, Stoi 2013; Frese et al. 2011).

Cost centers are resource oriented, their responsibility and basis of assessment is limited to meeting costs for determined deliverables. They provide transparency regarding resources used (input), rather than output achieved. A cost center approach is often used when the requested performance and capacities depend mainly on decisions made by other organizational units. With a cost center structure it is hardly possible to compare services on the market (Controlling Wiki 2015; Dillerup, Stoi 2013; Frese et al. 2011).

Revenue centers on the other hand are activity oriented and as the name suggests responsible for and assessed by their revenue generated. Resources and capacities to achieve this revenue are given, which incorporates cost center characteristics. When the performance can't be measured in monetary terms directly, other output parameters can be used. With a revenue center structure, services are comparable to services on the market (Controlling Wiki 2015; Dillerup, Stoi 2013; Frese et al. 2011).

The third type is success oriented. Profit centers are responsible for and assessed by not only input and output factors, but also the economic success of an organizational unit. Performance measures are ratios like EBIT or gross margin. In this respect, IT as a profit center decentralizes profit responsibility and owns responsibility and decision making rights to steer resources, processes and the IT portfolio. Services can be compared directly to the market, which expectably leads to increased efficiency and customer orientation. A Shared-Service-Center is a form a profit center that unites prior distributed internal services in an economically independent organizational unit and can be considered as "internal outsourcing" (Controlling Wiki 2015; Dillerup, Stoi 2013; Frese et al. 2011).

Investment centers possess the highest autonomy within the center concept. Besides profit responsibility they also have responsibility for investment decisions within the organizational unit. Profitability ratios such as return of investment are used as a measure of success. In order to avoid mismanagement, value-oriented earnings figures such as the economic value added are employed additionally. Investment centers are suitable for steering strategic business units or divisions. However, the boundaries between profit centers and investment centers are fluent. Profit centers can

for instance take investments into account by incorporating them in their definition of success (Controlling Wiki 2015; Dillerup, Stoi 2013; Frese et al. 2011).

Table 11 summarizes the four center types along their competencies and characteristics, as well as basis of assessment.

Center Type	**Competencies and Characteristics**	**Basis of Assessment**
Cost Center	▪ Performance not clearly measurable ▪ Decisions regarding use of resources ▪ Predetermined, fixed capacities	Meeting target costs or Cost/ Performance ratio
Revenue Center	▪ Performance is measurable through revenue delivered ▪ Decisions regarding use of resources in fixed cost-revenue-relation ▪ Predetermined, fixed capacities	Revenue or output
Profit Center	▪ Decisions regarding use of earnings ▪ Decisions regarding use of resources ▪ Predetermined, fixed capacities	Earnings or Gross Margin
Investment Center	▪ Decisions regarding use of earnings ▪ Decisions regarding use of resources ▪ Decisions regarding capacities and investments	Return of investment or Economic Value Added

Table 11: Center types, according to (Controlling Wiki 2015)

The cost structure of the IT organization is examined in reference to the four center types. T*able 12* summarizes the cost structure of IT as stated in the questionnaire.

Innovation Enabler	IT acts as an investment center, which accounts for all uses of capital. (Achieve value contribution)
	IT acts as a profit center, which is responsible for generating its own results and earnings. (Generate profit)
Solution Integrator	IT acts as a revenue center, which is responsible for its own revenue. (Generate revenue)
Efficient Operator	IT acts as a cost center, which does not produce direct profit and therefore adds to the cost of running an enterprise. (Meet target cost)

Table 12: Cost structure of IT

3 DATA AND METHODOLOGY

This section briefly discusses the chosen research type, approach and methodology, and sets up hypotheses based on the conducted literature review. Moreover it gives an overview of the survey design, data collection as well as employed data analysis methods.

3.1 Research Type and Approach

As discussed previously, connecting servitization and the strategic role of IT is a relatively new practice and lacks empirical research. This study aims to enable a deeper insight into the phenomenon of servitization by assessing it with regard to the role of IT and dynamic capabilities within surveyed manufacturing firms. Looking at the research questions, the quantitative research approach has the objective to add to answering research questions 2 and 3:

RQ2 What are dynamic capabilities and how can they support servitization?

RQ3 Which strategic role should the IT organization play to enable servitization?

Moreover, it is the objective of this study to generate and discuss a new perspective on the role of IT and dynamic capabilities in the context of servitization and derive managerial implications as well as ideas for further research.

3.2 Hypotheses

The conducted literature review connects the dynamic capability framework as well as the role of IT to servitization and serves as a basis for developing the hypotheses. The following hypotheses formulate the expected relationships between servitization and dynamic capabilities, respectively between servitization and the role of IT and thus address RQ2 and RQ3.

The hypotheses are listed in *table 13* and visualized in *figure 11.*

H1	Manufacturing firms with a strong service orientation employ dynamic sensing capabilities
H2	Manufacturing firms with a strong service orientation employ dynamic seizing capabilities

H3	Manufacturing firms with a strong service orientation employ dynamic reconfiguring capabilities
H4	When surveyed firms indicate a dominant Innovation Enabler role, the IT organization has a high importance for the development of PSS
H5	When surveyed firms indicate a dominant Innovation Enabler role, the IT organization has a high importance for the delivery of PSS
H6	When surveyed firms indicate a dominant Solution Integrator role, the IT organization has a high importance for the delivery of PSS
H7	When surveyed firms indicate a dominant Efficient Operator role, the IT organization has a low importance for PSS development
H8	When surveyed firms indicate a dominant Efficient Operator role, the IT organization has a low importance for PSS delivery

Table 13: Hypotheses

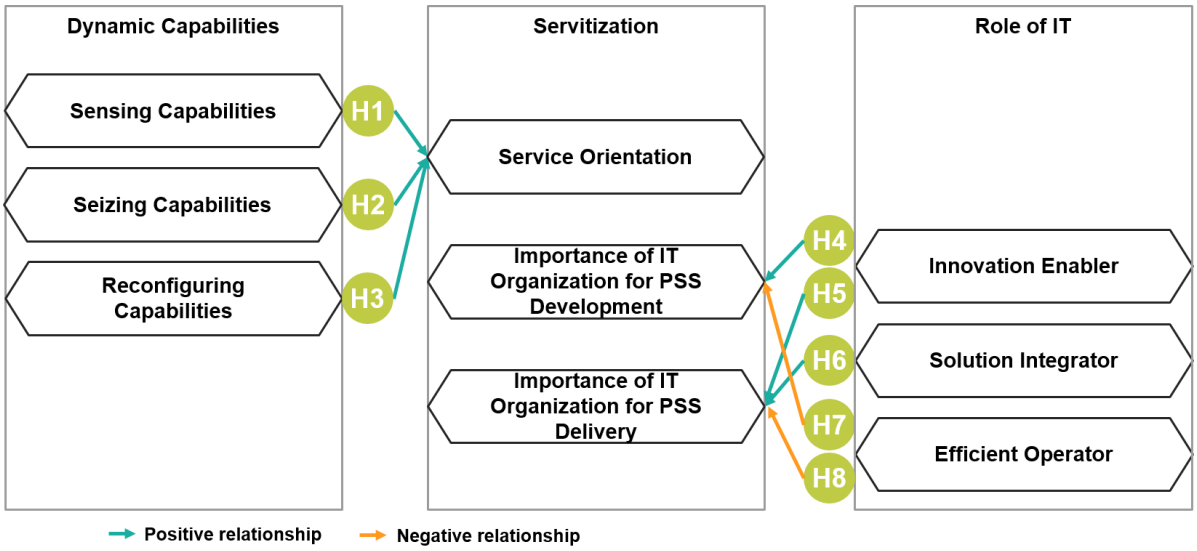

Figure 11: Hypotheses

3.3 Research Methodology

Quantitative research in comparison to qualitative research follows a more linear research path, proceeding with a clear step-by-step plan (Neuman 2013). This study employs a cross-sectional research design where the focus of the analysis is to find patterns of association in the relationship between the degree and importance of servitization, the current role of IT and the possession of dynamic capabilities in the surveyed manufacturing firms.

A cross-sectional research design implies assessing the current situation of several companies in the same industry at a single point in time in order to discover a relationship between measured items. Compared to longitudinal designs, the use of a cross-sectional design requires less effort from research participants and avoids complications related to finding and maintaining a sample population (Bryman and Bell 2011).

3.3.1 Quality of the Research

While following a quantitative research strategy, several factors should be considered to ensure reliability, replicability and validity of the findings.

Reliability as a criteria in business research means whether the results are repeatable. To ensure internal reliability, the indicators that make up the scale or index in this survey are consistent. The stability of a measure over time is difficult to control due to the complexity of influencing factors and general limitations in research design (cost and time). Most researchers therefore appear not to carry out tests for stability (Bryman and Bell 2011; Backhaus et al. 2016)

Replicability or inter-observer consistency is closely related to reliability and is concerned with the question of independence from the person carrying out the research. Hence, applied procedures should be described in great detail as considered in the following chapters (Neuman 2013).

The third and certainly most important criterion for research is validity. *"Validity is concerned with the integrity of the conclusions"*, which are produced by the research (Bryman and Bell 2011, p.42). Measurement validity is primarily applied in quantitative research and social science research fields and is concerned with the question whether the measure of a concept really measures the concept. If a concept is not directly quantifiable, indicators (questions) are necessary that stand for a concept and therefore allow it's measurement (Neuman 2013; Bryman and Bell 2011). The indicators used in the questionnaire were systematically developed throughout the *2. THEORETICAL FRAMEWORK* section of this study. Internal validity relates to conclusions that are drawn from the causal relationship between two or more variables. The causality discussion commonly discriminates between independent and

dependent variables. Independent variables, such as Sensing Capabilities, Seizing Capabilities, Reconfiguring Capabilities, Innovation Enabler role, Solution Integrator role, Efficient Operator role, are expected to have an effect on dependent variables such as the degree and importance of servitization, and the importance of the IT organization for PSS development and PSS delivery (Backhaus et al. 2016; Bryman and Bell 2011). Whereas external validity is concerned with the representativeness of the selected population and therefore with the potential generalization of findings beyond a specific case. It has to be mentioned that the generalization of findings generated by this study is limited due to the partial use of convenience sampling which is prominent in the field of business and management research (Neuman 2013). Bryman and Bell (2011, p. 236) argue that "...the sampling would not be representative of the population, even if everyone participated". The convenience sample is represented through an address list containing 450 manufacturing contacts and was provided by the industry partner.

3.3.2 Survey Design

The survey was designed and administered using the web-based software SoSci survey (https://www.soscisurvey.de/). The purpose of the survey was to report on the degree and importance of servitization, possession of dynamic capabilities and the current role of IT in manufacturing firms by generating quantitative data of organizational characteristics. Standardized online surveys are the most common technique to generate and obtain quantitative data, while ensuring sufficient objectivity of application (Eid et al. 2013). The survey was designed based on an intensive literature review and after consultation with professional researchers. The structure of the survey is shown in *figure 12* and the full survey as it has been conducted, is attached in the appendix.

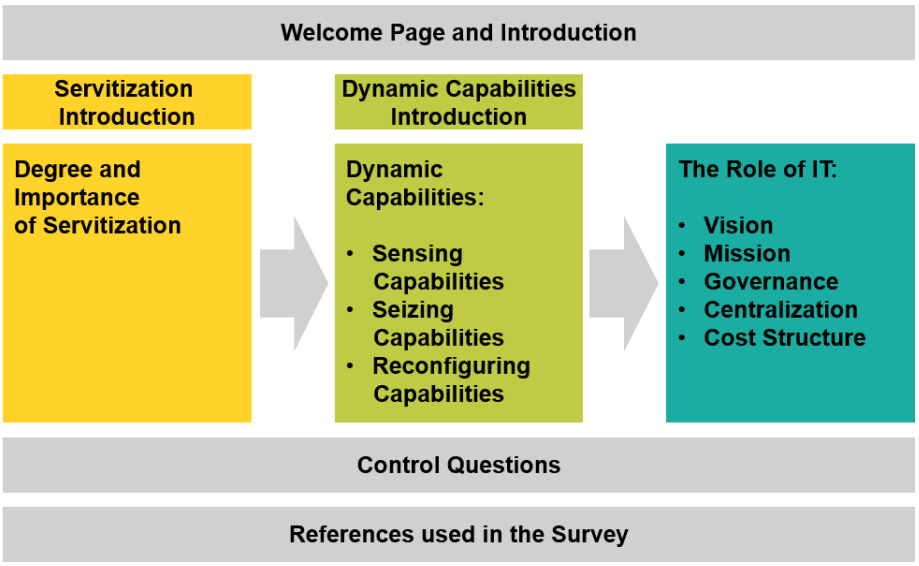

Figure 12: Survey structure

In order to consider potential problems arising from the reliance on just one single indicator, multiple-indicator measures were used to measure the concepts of servitization, dynamic capabilities, and the role of IT (Bryman and Bell 2011). For most questionnaire items, an ordinal 5 point Likert scale was used, ranging from 1 = ”not important at all” to “very important”, respectively from 1 = ”strongly disagree” to 5 = ”strongly agree”. Respondents specify their level of agreement on a symmetric scale when answering to these items (Neuman 2013). Whilst the level of agreement can be ranked, no distinct “value” can be placed. As an example, “strongly agree” is not twice as positive as “agree”. Other items such as the governance responsibility, governance degree of centralization and cost structure of IT were measured on a nominal scale.

Before the survey was published, a pre-test and a technical test were employed in order to ensure comprehensibility of the stated questions and validity of the data. Moreover, the design considered an easy-to-follow design approach, avoided open questions where possible and focused on the length of the questionnaire. For the pre-test, six colleagues from different hierarchy levels, all familiar with IT strategy and working with manufacturing clients, were asked to provide feedback. After their agreement, a pre-test hyperlink was created using the SoSci pre-test function and sent to the testers via email. They could access the questionnaire with the provided link and leave comments in designated text input fields. After incorporating the feedback, a technical test was carried out to ensure that all questions appear in the questionnaire, all statements are saved correctly, and the import of data for the analysis later on works as expected. First, the variable set was printed, second the questionnaire was

completed using different browsers (Internet Explorer, Google Chrome, Safari, Firefox) and selected answer were written down. In a third and final step, the downloaded dataset was imported in SPSS and compared to the notes made.

3.3.3 Data Collection

This study employs a web-based, quantitative questionnaire in order to collect data of organizational characteristics, which can be statistically analyzed later on. No secondary sources are available for most of this data because the measurement requires deep knowledge of the manufacturing industry and information technology, as well as service development and delivery in the respective firm.

The survey targeted primarily manufacturing firms that were already established in their respective market. More specifically, the target population were employees with knowledge of information technology, service development and delivery, business development or innovation management activities in their firms. Various demographic measures (Control Questions), such as the industry, firm age, firm size, organizational unit of the employee, position of the employee, duration of the employment within the company, and the age of the employee, allow comprehensive information about the respondents in the survey. Moreover the experience of the respondent with PSS was inquired.

The data was collected using multiple channels between the 12th of July 2016 and the 15th of August 2016. The survey was conducted in English in order to avoid misconceptions of the concepts resulting from translation (Eid et al. 2013) and was initially sent to an address list containing 450, primarily German manufacturing contacts, on the 12th of July. A first reminder followed after one week (19th of July) and a second and final reminder was sent on the 2nd of August. A third reminder was not sent in order to avoid intrusiveness, taking into account that the provided contacts are customers of the industry partner. Simultaneously the survey was published twice on all available corporate social media channels (Facebook, LinkedIn, Twitter, Xing), including the Xing Alumni network. The first set of postings was made on the 22nd of July and a second one on the 1st of August. Additionally, the link to the questionnaire appeared in the quarterly corporate newsletter on the 27th of July. The newsletter is received by approximately 3500 subscribers. In order to further leverage professional social media channels, an extensive search for suitable LinkedIn and Xing groups was

undertaken. The search utilized search terms listed in *table 1*, as well as “Business Development”, “Innovation Management”, and “Information Technology Management”, and resulted in 18 LinkedIn and 9 Xing groups. Membership was requested for all closed groups, resulting in access to 14 LinkedIn and 7 Xing groups. The survey was published first on the 18th of July with a first reminder following on the 1st of August, and a final reminder being sent on the 8th of August.

All emails sent and postings made included a short description of the study, the estimated time needed for participation, the link to the survey, as well as the offer to provide the results of the study to participating firms.

Table 14 shows the channels which were used in the data collection process as well as the dates.

Channels	Dates
Manufacturing address list	12th of July; 19th of July; 2nd of August
Corporate Social Media Channels (Facebook, LinkedIn, Twitter, Xing)	22nd of July; 1st of August
Corporate Newsletter	27th of July
Designated LinkedIn and Xing groups	18th of July; 1st of August; 8th of August

Table 14: Data collection summary

3.4 Data Analysis and Demographic Information

Even though the survey was run for more than one month, utilized different channels, and a lot of effort was put into its distribution, only 23 data sets could be collected. The survey results were analyzed and plotted using the statistical program SPSS. The program was mainly chosen due to its popularity for analyzing quantitative social science research. SPSS enables to examine the relationship between variables, using complex correlation and multi regression analysis, as well as relatively straight forward descriptive statistics.

Email as a distribution medium created 11 responses, whereas the remaining 12 responses resulted from social media postings and the corporate newsletter. The 11 answers received from the provided manufacturing address list represent a response rate of 2%, while the response rates from social media channels and the corporate newsletter were considerably lower. Two of the received data sets had to be excluded

due to no information provided regarding the degree and importance of servitization and two further responses could not be considered because more than 50% of the questions were left blank. Hence, the resulting sample size is 19 (N=19).

Bryman and Bell (2011) refer to a non-response problem, which is of particular significance for survey research. Several researchers indicate a declining response rate to surveys which implies a growing general tendency towards people refusing to participate in survey research. Nevertheless, due to varying research settings and respondent types, it is difficult to find consistent evidence for this observed tendency (Bryman and Bell 2011). A high non-response rate, as experienced in this survey, implies a sample bias and challenges the researcher to find other ways to analyze the sample. As a result, descriptive statistics were chosen to quantitatively describe the main features of the collection of information. Rather than using the data to learn about a population, descriptive statistics aim to summarize a sample (Eid et al. 2013). In the following, descriptive statistical methods, such as frequency analysis and cross tabulation are used with the purpose to discover trends in coherences in the data and hence reject or not reject the stated hypotheses. Due to the low sample size one has to expect that the relationship (dependency) between variables has a very low statistical significance in many cases. Literature suggests at least 50 randomly-selected participants to keep the estimated margin of error below 15 percentage points. For a sample size of only 20, the estimated margin of error is 22 percent (Backhaus et al. 2016). Hence, to address the given research limitations, this study speaks about trends rather than statistical evidence when answering the stated hypotheses. The cross tabulations between two ordinal variables, as utilized in this study, show patterns of association and can moreover reveal the direction of the relationship. A positive relationship is given when cases with a high independent variable also have high values on the dependent variable, while a negative relationship refers to situations in which a high value on the independent variable occurs with a low value on the dependent variable. In order to provide a directional as well as a symmetric measure of association for the ordinal variables, Somer's d was plotted for each investigated cross table (Neuman 2013). Once again, while interpreting the directional relationship based on the Somer's d measure, one has to be aware of the error margin, resulting from the small sample size. Together with all cross tabulations and Somer's d outputs,

processing summaries that show valid sample sizes as well as missing data are attached in the appendix.

This section analyzes the demographic structure of the sample. All tables and descriptive methods used as a basis for the results and interpretations are attached in the appendix.

Following the industrial classification provided by Detecon, surveyed companies were divided into the categories “Automotive and Suppliers”, “High-tech”, “Manufacturing”, “Pharma & Health” and “Other Industry”. Out of 19 respondents, 11 respondents (58%) worked in the automotive and suppliers industry, 5 in manufacturing, 2 in high-tech, and 1 respondent didn’t further specify any industry (*Demographics Table 1)*. With 84%, the majority of surveyed firms employs more than 10.000 people (16 out of 19), while 2 firms employ between 1.001 to 10.000, and 1 firm less than 50 employees (*Demographics Table 2)*. Respondents held mostly management positions (12 out of 19) (*Demographics Table 3)* in the organizational units IT (8), Sales (4), Business Development (2), Innovation Management (1), Strategy (1), and Financial Services (1). One respondent described his or her organizational unit as “Operation”, whereas another didn’t answer the question (*Demographics Table 4)*. In their profession, 14 of the respondents have been confronted with the development of PSS, of which 11 respondents stated that they experienced it in 10 or more cases (*Demographics Table 5)*. Moreover, the respondents’ age ranged from 42 to 68 (*Demographics Table 6)* and each respondent worked for at least 4 years for the firm which was subject of the inquiry (*Demographics Table 7)*.

4 RESULTS AND DISCUSSION

In this concluding chapter, the results of the quantitative study are presented and reflected against the theoretical findings. Managerial implications are derived and a critical position is taken regarding the limitations of this study. Finally, suggestions and ideas for further research are given.

4.1 Survey Results

The results of data analysis are presented and reference is made to the hypotheses, following the general structure of the study. First, general observations on servitization are presented, before secondly examining dynamic capabilities, and thirdly the role of IT in relation to servitization.

4.1.1 General Observations on Servitization

As far as the current importance of PSS for the enterprise was not already indicated with the highest available value “very important”, all except for 2 respondents expect an increasing importance of PSS in the future. Expressed as a percentage, while currently 24% of the respondents view PSS as very important for their firm, 76% expect PSS to be very important in the future *(Servitization Table 1 and 2)*. Similarly, all except for 3 respondents expect that the service orientation in their enterprise’s policies, practices and procedures will increase as long as it has not already been indicated with “very important”. At present 24% of the respondents view service orientation as very important in their firm’s policies, practices and procedures, whereas 71% estimate service orientation to be very important in the future *(Servitization Table 3 and 4)*. The service share, estimated as the percentage of the total revenue of the surveyed firm generated through services is not further considered due to the incompleteness of the received data.

The importance of PSS for the surveyed firm was expected to capture a rather external perspective due to a strong dependence on the industry and competitors behavior, while the measure “service orientation” is assumed to focus on internal characteristics. Consequently, the dynamic capability variables were measured against the current service orientation. Besides examining the degree (service orientation) and importance (importance of PSS) of servitization, as well as the expected future development of

both, the surveyed firms were asked to rate the current importance of their IT organization for the development of PSS and for the delivery of PSS. While only 7 out of 19 (37%) respondents assign their IT organization currently an important or very important role for the development of PSS *(Servitization Table 5)*, the majority (12 out of 19, or 63%) sees the IT organization currently as important or very important for the delivery of PSS *(Servitization Table 6)*. Furthermore, the importance of the IT organization for the delivery of PSS is at least indicated with “moderately important”.

4.1.2 Dynamic Capabilities

Values for the three dynamic capabilities sensing, seizing and reconfiguring were computed as a mean function of the collected multiple-indicator measures. Subsequently the three dynamic capabilities were mapped with service orientation as dependent variable, using the SPSS cross tabulation function in order to identify trends and address the stated hypotheses. Owing to the small sample, the significance has to be challenged.

The hypothesis that firms with a strong current service orientation possess dynamic sensing capabilities was not rejected based on the cross table analysis. 9 out of 11 firms where service orientation is either important or very important clearly confirm to have dynamic sensing capabilities *(Crosstab 1)*. Additionally, Somer’s d was run to determine the association between current service orientation and dynamic sensing capabilities amongst 18 participants. There is a positive relationship (d = .379) between the ordinal variables with a statistical significance of p = 0.013 *(Directional Measures 1)*.

Furthermore, the hypothesis that firms with a strong service orientation possess dynamic seizing capabilities was rejected. Only 3 out of 10 respondents who report current service orientation to be important or very important, clearly indicate to have dynamic seizing capabilities in their firms *(Crosstab 2)*. The directional measure analysis reveals a positive relationship with p = .295 but a low approximate significance of p=0.17 *(Directional Measures 2)*.

Investigation of dynamic reconfiguring capabilities show 5 out of 10 firms with high service orientation confirming their possession *(Crosstab 3)*. Even though a weak trend seems to be noticeable, after considering the low significance level of p= 0.201, hypothesis 3 was rejected (d = 0.275, *Directional Measures 3).*

The following *table 15* summarizes the discovered trends and thus answers the hypotheses based on the conducted data analysis.

H1	Manufacturing firms with a strong service orientation employ dynamic sensing capabilities	Not rejected
H2	Manufacturing firms with a strong service orientation employ dynamic seizing capabilities	rejected
H3	Manufacturing firms with a strong service orientation employ dynamic reconfiguring capabilities	rejected

Table 15: Hypotheses related to dynamic capabilities

4.1.3 The Role of IT

The role of IT, as developed in this study is composed of the vision statement, the mission statement, the governance responsibility for service innovation, the degree of centralization for IT portfolio decisions and the cost structure of IT. In order to analyze the sample in regard to the relationship between the vision, respectively mission of IT and servitization in the surveyed firm, the SPSS cross tabulation function was used. The governance responsibility and cost structure variable were analyzed utilizing frequency analysis, which can be justified by the homogeneity of the obtained answers. The governance degree of centralization was mapped with the importance of IT for PSS development and PSS delivery in a cross table, but since the variable is nominal, no directional measures were run.

In 78 percent of the answered cases (14 out of 18) respondents indicate joint responsibility of business and IT for service innovation projects and delivery within their firms. 17% or 3 out of 18 firms assign no responsibility to IT, while in 1 firm, IT appears to have sole responsibility for service innovation projects and delivery *(Frequency Table 1)*. Joint responsibility indicates a tendency towards the Solution Integrator role.

Regarding the cost structure, the IT organization in most of the surveyed firms (83%) is constituted following a cost center logic, whereas in only 2 out of 18 observed cases the IT controlling is set up as an investment center and in one case as a revenue center *(Frequency Table 2)*. For this measure, more diversity and especially a stronger representation of revenue centers and profit centers was expected. While an investment center logic supports the role of IT as Innovation Enabler, a cost center

logic widely imposes decisional restrictions and compromises sovereignty of the organizational unit. Therefore, the share of IT organizations following cost center accounting while addressing a strong Innovation Enabler or Solution Integrator role in the remaining components is surprising. There was no potential correlation discovered between the three deviating responses and other items.

Concerning the degree of centralization for IT portfolio decisions, 9 firms have a decentralized governance model, 6 a federalized model and 3 report a centralized governance model. One respondent did not provide any answer. Mapping the degree of centralization against the measures of “importance of the IT organization for the development of PSS” and “importance of the IT organization for the delivery of PSS” shows that firms with a high importance of their IT organization for PSS tend to have either decentralized or federalized governance models in place. 4 out of 6 respondents with a high importance of IT for PSS development and 7 out of 11 with a high importance of IT for PSS delivery state a decentralized model, while the remaining 2, respectively 4 have a federalized model *(Crosstab 4 and Crosstab 5)*. Even though the centralized model is underrepresented in general, this leads to the assumption that a centralized governance model, which represents the Efficient Operator role does not support the contribution of IT to PSS development and delivery.

Following the same approach as for the dynamic capabilities, the IT vision was constructed as a mean of the multiple-indicator measures. Thereafter, the vision and mission measures, representing the three roles of IT (Innovation Enabler, Solution Integrator and Efficient Operator) were put into relation with the importance of the IT organization for PSS development, respectively PSS delivery. For the analysis, cross tabulation was used to map the given answers against each other.
Especially respondents (N=19) who indicated a high importance of IT for the development of PSS seem to agree or strongly agree with the Innovation Enabler vision (6 out of 7, *Crosstab 6)*. The Somer’s d = .617 determines a strong positive association between the Innovation Enabler vision and the importance of IT for PSS development. According to the descriptive analysis, the value is statistically significant with $p < .0005$. Nevertheless, the overall confidence level of the sample results is relatively low due to the low sample size of N=19 *(Directional Measures 4)*. Regarding the importance of IT for the delivery of PSS and the Innovation Enabler vision, the

trend seems to be less distinct with 7 out of 12 responses *(Crosstab 8)*. There is a positive relationship (d = .368) between the variables which shows a calculated significance of p= .044 *(Directional Measures 5)*. The cross tabulation for the importance of the IT organization for PSS development and the Innovation Enabler mission (d = .595, p < .0005, *Directional Measures 10 and Crosstab 12*), as well as for the importance of the IT organization for PSS delivery yield very similar results (d = .421, p = 0.008, *Directional Measures 11 and Crosstab 13*).

The Solution Integrator vision examined with the same procedure shows a trend towards a positive correlation with the importance for PSS delivery, but not for the importance for PSS development. Respondents who assess the current importance of their IT organization for PSS delivery as either important or very important tend to agree or strongly agree with the solution integrator vision (7 out of 12) while the remaining 5 respondent answered “undecided” *(Crosstab 7)*. The association was determined with d = .358 and a significance level of .079 after running a Somer’s d analysis *(Directional Measures 7).* As one would expect, the cross tabulation for the Solution Integrator mission yields a very similar outcome for PSS delivery (d = .439, p = .019, *Directional measures 13 and Crosstab 15*). Regarding the important and very important “PSS development” respondents, 4 of 7 respondents agree or strongly agree with the mission *(Crosstab 12)*. In contrast to the Solution Integrator vision, a positive relationship (d = .307) and a comparably higher significance (p = .085) were found for the importance of IT for PSS development and the Solution Integrator mission *(Directional Measures 12).*

No trend in the responses could be identified for the Efficient Operator vision and mission *(Crosstab 10 and Directional Measure 8, Crosstab 11 and Directional Measure 9, Crosstab 16 and Directional Measure 14, Crosstab 17 and Directional Measure 15)*.

As a result of the investigation of the constructed Role of IT measures and the discovered trends in association with the importance of the IT organization for PSS development, respectively PSS delivery, Hypotheses H4 to H8 can be answered *(Table 16)*. It should be stressed once again that the rejection or non-rejection of hypotheses was based on trends rather than statistically significant representativeness. Derived from the discovered trends, the hypotheses that a dominant Innovation Enabler role has a positive relationship with the importance of IT for PSS development (H4), as well as for the importance of IT for PSS delivery (H5)

are not rejected. Moreover, a dominant Solution Integrator role seems to be positively related to the importance of the IT organization for PSS delivery. No tendency was found in order to not reject H7 and H8: “When surveyed firms indicate a dominant Efficient Operator role, the IT organization has a low importance for PSS development / PSS delivery”, which expresses a negative relationship between the variables.

H4	When surveyed firms indicate a dominant Innovation Enabler role, the IT organization has a high importance for the development of PSS	Not rejected
H5	When surveyed firms indicate a dominant Innovation Enabler role, the IT organization has a high importance for the delivery of PSS	Not rejected
H6	When surveyed firms indicate a dominant Solution Integrator role, the IT organization has a high importance for the delivery of PSS	Not rejected
H7	When surveyed firms indicate a dominant Efficient Operator role, the IT organization has a low importance for PSS development	rejected
H8	When surveyed firms indicate a dominant Efficient Operator role, the IT organization has a low importance for delivery	rejected

Table 16: Hypotheses related to the Role of IT

4.2 Conclusion and Managerial Implications

As presented in the literature review, the servitization trend in manufacturing firms will impose new and to some extent contradictory requirements on organizations and information technology in particular. In addition, organizations need to react upon inevitable technological trends such as the Internet of Things (IoT), Artificial Intelligence (AI) and Big Data science (Gerick 2014). Survey respondents expect an increasing importance of PSS and service orientation for their firms in the future. Thus it can be reasoned that the currently already significant importance of the IT organization for PSS delivery will most likely further increase. Accordingly, the importance of the IT organization for PSS development which was indicated as lower compared to PSS delivery might play a crucial role in the future. With new requirements due to the continuous merger of products and ICT-enabled services, firms should reconsider the future core capabilities of an IT organization and dependencies arising from sourcing decisions. It seems contradictory at first, but Gerick (2014) argues that the growing importance and integration of information technologies within the whole enterprise is likely to be accompanied by the IT organization’s loss of influence and

autonomy. Single business units seem to increasingly aim for an autonomous IT and not seldom decide upon IT investments without consulting with the IT organization. Reasons for such autonomy endeavors might be a lack of agility and innovation or an insufficient compatibility of products and services compared to the market. The development and provision of complex PSS demand not only new capabilities, but also an increasingly close integration between what is loosely referred to as business and IT. This accustomed, distinct divide between business and IT is part of the problem many manufacturing firms will most probably face when pursuing a servitization strategy. The divide automatically draws on the traditional view of IT as a support function where the main contribution of IT is seen in the automation of manual processes, tying IT closely to established business processes (Zimmermann 2013).

The conducted quantitative study indicates a positive connection between dynamic sensing capabilities and a strong current service orientation. For dynamic seizing and reconfiguring capabilities, no trend could be spotted, which does not necessarily mean that they are less important. Sensing capabilities focus on the detection and shaping of technological and market opportunities, as well as threats. Seizing and reconfiguring capabilities in contrast aim to address opportunities and threats, and to achieve the needed balance between service strategy and organizational design. Regarding the role of IT, most of the respondents indicated a joint responsibility of business and IT for technology and service innovation projects and delivery in their firms. Together with the as predominant observed decentralized and federalized governance models for IT investments, this evermore necessitates an alignment between business and IT.

The idea of alignment between business and IT is by far not new. Several alignment models emerged in the early 1990s with the aim to explain the connection and advise adjustment from a holistic and prescriptive perspective. The probably most widely cited alignment model was developed by Henderson and Venkatraman (1993) and influenced by the MIT research (Chan, Reich 2007). In the Strategic Alignment Model (SAM), as shown in *figure 13*, the four key domains of business strategy, organizational infrastructure and processes, IT strategy, and IT infrastructure and processes are aligned through linkages between any three of these domains. The concept of strategic alignment is based on strategic fit and functional integration between the four key domains. Henderson and Venkatraman (1993) discriminate not only between an

external (IT strategy) and an internal perspective of IT (IT infrastructure and processes) in their model, but also recognize the potential of IT to contribute to business development. The strategic fit dimension already aimed to dispel the misconception that *"...I/S strategy has often been viewed as a functional, internal response to the business strategy"* (Henderson and Venkatraman 1993, p.3), where "*…I/T is a support function not essential to the business of a firm."* (Henderson and Venkatraman 1993, p.4).

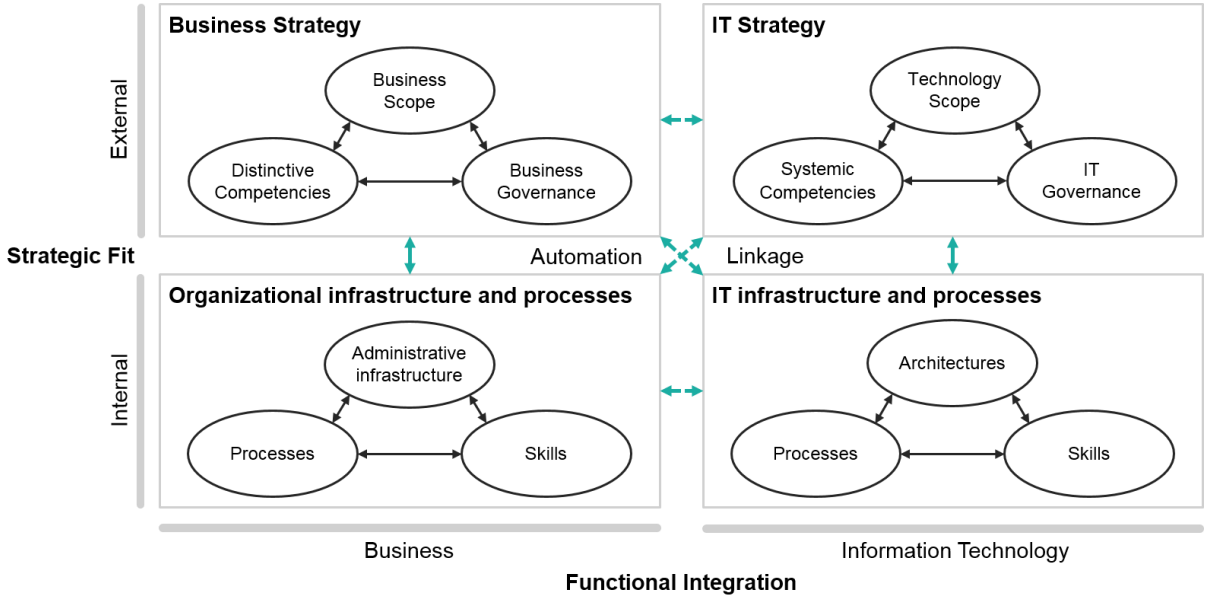

Figure 13: Strategic Alignment Model (Henderson and Venkatraman 1993)

Functional integration as the second dimension takes into account how choices made in the IT domain influence those made in the business domain and vice versa. The model specifies two types of integration, termed strategic integration and operational integration. Strategic integration addresses the potential of IT to shape and support external business, while operational integration deals with the internal coherence between requirements and the delivery of organizational capabilities (Henderson and Venkatraman 1993).

Bringing the SAM in the context of servitization *(figure 14)*, one could argue that strategic integration has the task to choose the strategic objective or role of IT consistent with the firm's external business intentions. In accordance with the here developed roles of IT, Sia et al. (2010) differentiate between the three strategic IT objectives: scale economies, responsiveness to business needs, and innovation. They argue that even though the three objectives raise conflicting or even contradictory

requirements, organizations seek to achieve all of them simultaneously (Sia et al. 2010). Trends towards a positive relationship between a strong Innovation Enabler role of IT and an as high indicated importance of the IT organization for PSS development, respectively PSS delivery were discovered in the survey data. Moreover, a strong Solution Integrator role appears to be positively related to the importance of IT for PSS delivery. The phenomenon described by Sia et al. (2010) was strongly observed when survey respondents were asked to rate the multiple indicators building the vision and the statements representing the mission of their IT organization. Hence, in practice a clear divide between the different roles of IT seems to be hardly possible. Consequently, this study argues that one major challenge for the strategic alignment is to balance between scale, responsiveness, and innovation.

The operational integration of the SAM is concerned with the building and delivery of organizational capabilities, which are required to carry out the firm's strategic objectives. Based on the theoretical framework, one could argue that focus on the Efficient Operator role could favor operational capabilities, while focus on the Innovation Enabler role could reinforce dynamic capabilities.

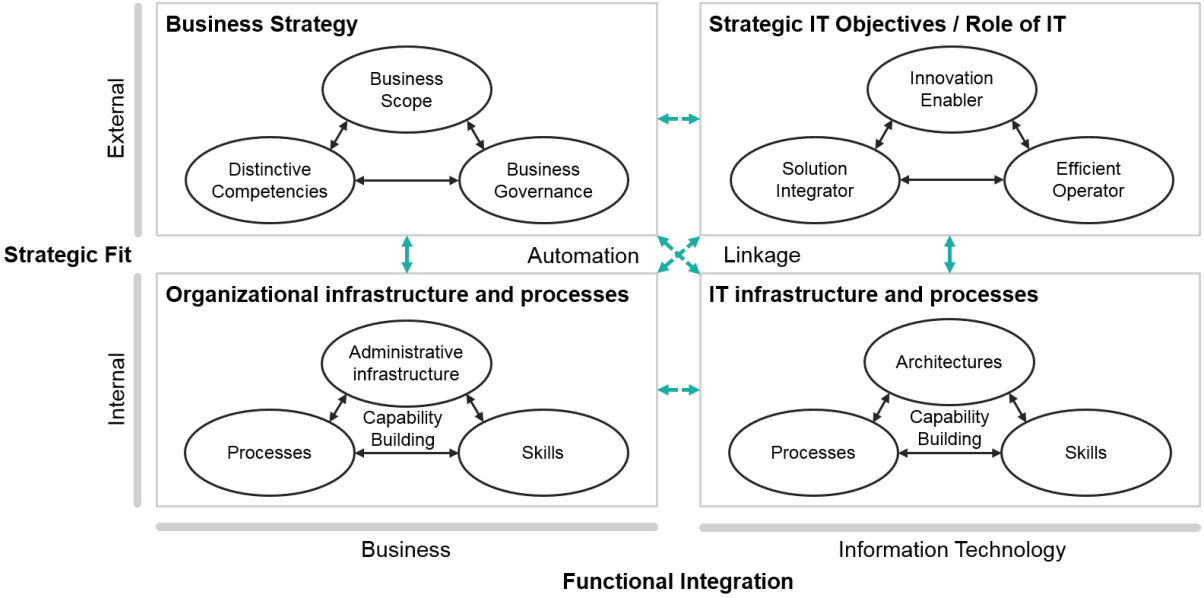

Figure 14: Modified Strategic Alignment Model (Henderson and Venkatraman 1993)

Ultimately, it is important to view the alignment of business and IT only as a temporary situation or rather as an ongoing process.

The discussed external business orientation and expected value contribution of the three roles of IT is visualized in *figure 15* according to (Hanschke 2013). While the role of IT as Efficient Operator has an operational focus and relatively low external orientation and value contribution, IT as Innovation Enabler has a strong strategic impact and external orientation. The third role, IT as Solution Integrator, lies in between in both dimensions.

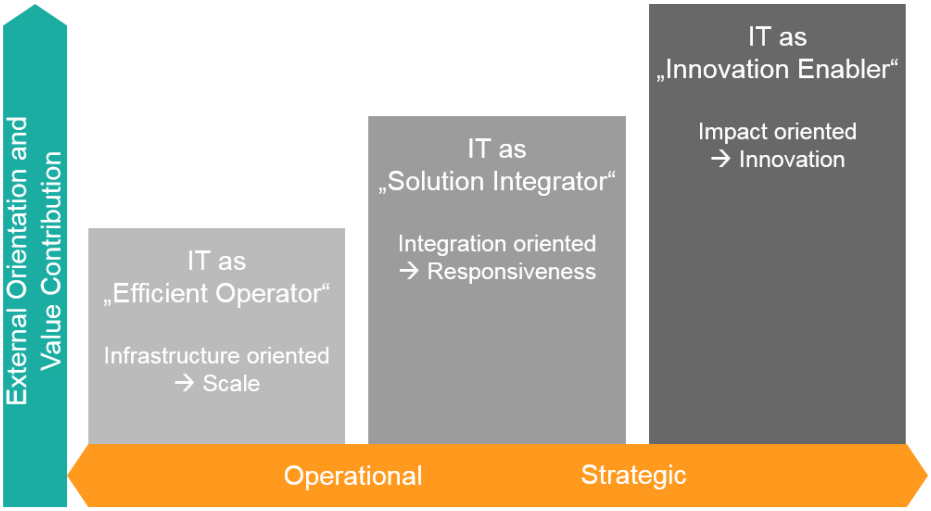

Figure 15: Value contribution of IT roles, based on (Hanschke 2013)

Based on the conducted analysis, this study suggests that manufacturing firms pursuing servitization goals should position their IT increasingly for external business orientation and value contribution. In other words, the IT organization should transition from a pure technology towards a service focus, which necessitates profitability of operations and a close alignment with business (Zimmermann 2013; Gerick 2014). This transition from a traditional, support oriented IT towards a modern digital business demands a radical change of what is classified as “the role of IT” in this study.

The arising question within the next years therefore should not be if manufacturing firms will need capabilities for the development and delivery of PSS but rather who is providing them. This means for the IT organization either to gain strategic importance and expand its activities in new fields or to continuously lose competencies and being exposed to the risk of becoming obsolete for servitization and business development.

4.3 Limitations

This work is subject to the following limitations. First of all, since a quantitative survey analysis was chosen for collecting data on company capabilities, characteristics and

behavior, all conclusions should be merely interpreted as tendencies, but not as causalities. The effect is drastically increased in this work, due to the only small sample that could be drawn from the executed survey. Owing to the small sample size as well as the inclusion of convenience sampling, the respondent's answers yield no representativeness or generalization beyond the study sample (Neuman 2013; Bryman, Bell 2011). Other potential limitations which might also affect the generalization of findings are the industry and country specific characteristics underlying this study. Among German industrial manufacturing firms, the Automotive and Suppliers Sector is overrepresented in comparison to other countries, which is reflected by the here conducted survey with 58% of the respondents representing the Automotive and Suppliers sector. Furthermore, the descriptive analyses were performed using a sample of N=19, even though the sample included two incomplete data sets. The missing data can be attributed to respondents not answering single questions in the survey. Not accounting for incomplete data sets, only 17 would have been left for further analysis. In order to not further reduce an already small sample, descriptive analysis were performed with the sample of N=19, as well as the subset of complete answers (N=17) with the aim to identify significant differences. Since no potential bias could be found, it was decided to keep the sample with 19 responses (Streiner 2002). The limitation to employees with knowledge about PSS and strategic characteristics of information technology in their respective enterprise added increasing complexity to the research process and therefore contributed to the difficulty of obtaining a larger sample.

4.4 Suggestions for Further Research

Due to the sample size and the chosen research structure, only separate considerations of the effect of dynamic capabilities and characteristics of the IT organization on servitization could be taken into account. Future research might obtain better results by applying mixed methods (Creswell 2013). Hence, this study suggests that especially the influence of the role of IT on servitization should be investigated further by adding qualitative elements (e.g. interviews) to gather in-depth knowledge on PSS development and PSS delivery in manufacturing firms. Using a combined approach would allow to gather further information and integrate them with the survey results.

Due to the nature of cross-sectional studies, there is a lack of confidence regarding the direction of causality between dynamic capabilities, the role of IT and servitization. Consequently, longitudinal research design would be necessary to examine the direction of causality and to measure change over time.

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APPENDIX

Servitization Survey

DETECON CONSULTING

UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

Seite 01
Introduction

Dear Participant,

Thank you for taking the time to participate in our research on servitization within manufacturing firms.

This survey is part of a Master Thesis in cooperation with Detecon Consulting and the University of Gothenburg. Aim of the study is to analyze how IT can contribute to servitization in manufacturing firms.

The questionnaire is divided into three parts, initially measuring the degree and importance of “servitization”, secondly examining the “role of IT”, and thirdly enquiring “dynamic capabilities”. It will take approximately 10 to 15 minutes to fill out the survey and your progress can be tracked in the bar in the bottom right corner.

Servitization as well as the concept of dynamic capabilities will be introduced briefly in order to ensure a clear and common understanding of the terms.

Please answer all questions as honestly as possible based on your experience and expertise, and complete the questionnaire.

All data gathered in this survey will be treated anonymously and no information about your enterprise or your identity will be retained or shared. We will share the results of the study with you and are confident that your enterprise will profit from the results of the study and get an insight into how IT can enable servitization in manufacturing firms.

Best regards,

Klaus Schrenker

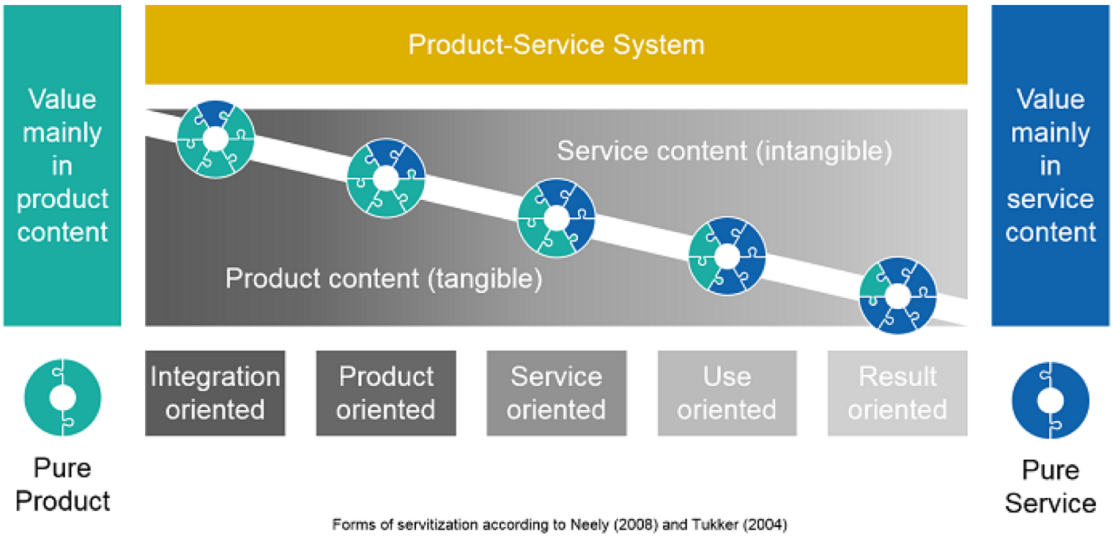
Seite 02
ST

What is Servitization?

For the purpose of this study, we adopt the view of Baines et al. 2009 who define servitization as:

“*...the innovation of an organizations capabilities and processes to better create mutual value through a shift from selling products to selling Product-Service Systems*” (Baines et al. 2009, p. 4)

Product-Service Systems are integrated product and service offerings, that deliver value in use.



Forms of servitization according to Neely (2008) and Tukker (2004)

Part 1:

The following questions aim to assess the degree and importance of servitization in your firm.

We are interested in your personal experience and opinion regarding the development and delivery of services.

How often have you approximately been confronted with the development of integrated product-service offerings in your profession?

Number of times

How important are integrated product-service offerings currently for your enterprise?

Not important at all	Of little importance	Moderately important	Important	Very important
○	○	○	○	○

How important will integrated product-service offerings become for your enterprise in the future?

Not important at all	Of little importance	Moderately important	Important	Very important
○	○	○	○	○

How important is service orientation in your enterprise's current policies, practices and procedures?

Not important at all	Of little importance	Moderately important	Important	Very important
○	○	○	○	○

How important will service orientation become for your enterprise in the future?

Not important at all	Of little importance	Moderately important	Important	Very important
○	○	○	○	○

How important is the IT department currently for developing integrated product-service offerings?

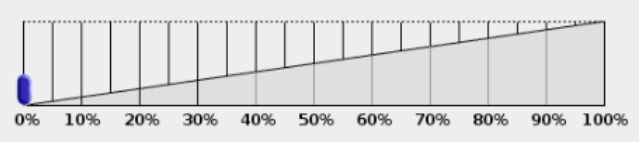
Not important at all	Of little importance	Moderately important	Important	Very important
○	○	○	○	○

How important is the IT department currently for delivering integrated product-service offerings?

Not important at all	Of little importance	Moderately important	Important	Very important
○	○	○	○	○

Which share of your enterprise's total revenue is currently created through services?

Please give a rough estimation of the value in %

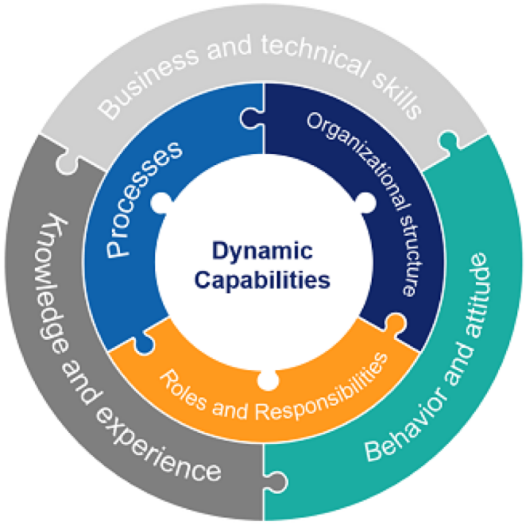


What are dynamic capabilities?

A **capability** is a set of routines, which enables a firm to produce a particular outcome in relation to its overall mission.

Operational capabilities enable a firm to maintain the current business processes in an effective and efficient manner to earn a living at present.

Dynamic capabilities on the other hand consider the evolutionary nature of resources, they identify the need or opportunity for change, formulate a response, and implement a course of action.



Resource level:
Identification of key knowledge, skills and experience which is accessible through employees and partners

Organizing level:
Mobilization and deployment of resources via organizational structures, processes and roles

(Dynamic) Capability model based on Peppard and Ward 2004

Capability Concept according to Teece 2007; Gebauer et al. 2010; Winter 2003

Part 3:

The following statements aim to asses the dynamic capabilities of your firm.

Please rate the following statements according to their fit with your firm's capabilities.

Dynamic Sensing Capabilities

	Strongly disagree				Strongly agree	I don't know
My firm continuously captures customer needs and identifies target market segments.	○	○	○	○	○	○
My firm exploits supplier and complementary innovation.	○	○	○	○	○	○
My firm identifies threats and opportunities in the extended value chain and such related to competitors' behavior.	○	○	○	○	○	○
My firm explores new technologies and developments in exogenous science.	○	○	○	○	○	○
My firm directs internal R&D and selects technologies based on above listed sensing activities.	○	○	○	○	○	○

Dynamic Seizing Capabilities

	Strongly disagree				Strongly agree	I don't know
My firm describes the customer solution and the corresponding business model in detail.	○	○	○	○	○	○
My firm identifies connections between existing capabilities and requirements of emerging opportunities.	○	○	○	○	○	○
My firm experiments with new service opportunities through close interaction with customers.	○	○	○	○	○	○
My firm implements decision-making protocols to avoid decision errors and tendencies for anti-cannibalization.	○	○	○	○	○	○
My firm selects enterprise boundaries to manage complements and to control platforms.	○	○	○	○	○	○
My firm integrates whole business processes of the customer.	○	○	○	○	○	○

Dynamic Reconfiguring Capabilities

	Strongly disagree				Strongly agree	I don't know
My firm adopts loosely coupled structures and develops integration and coordination skills.	○	○	○	○	○	○
My firm achieves incentive alignment and avoids agency issues.	○	○	○	○	○	○
My firm manages co-specialization so that asset combinations are value enhancing.	○	○	○	○	○	○
My firm builds loyalty and commitment to services.	○	○	○	○	○	○
My firm establishes knowledge management to transfer and integrate know-how.	○	○	○	○	○	○
My firm scales up successful service innovations based on standardization and consolidation.	○	○	○	○	○	○
My firm creates a consistent service experience for customers, independent from the location and involved partners.	○	○	○	○	○	○

Seite 06
IT

Part 2:

The following statements aim to assess the current role of IT in your firm.

Please rate the following statements according to their fit with your firm's IT function.

IT "Vision"

	Strongly disagree				Strongly agree	I don't know
IT drives first mover advantage through innovative solutions.	○	○	○	○	○	○
IT tailors offerings that outperform business demands.	○	○	○	○	○	○

	Strongly disagree				Strongly agree	I don't know
IT continuously enhances business operations with leading-edge solutions.	○	○	○	○	○	○
IT defines future requirements together with business.	○	○	○	○	○	○
IT integrates solution partners to meet future requirements.	○	○	○	○	○	○

	Strongly disagree				Strongly agree	I don't know
IT operations and solutions are provided with a maximum of availability and reliability.	○	○	○	○	○	○
IT infrastructure is established to manage cross-unit synergies across the firm and to ensure a maximum of cost-effectiveness.	○	○	○	○	○	○

IT "Mission"

	Strongly disagree				Strongly agree	I don't know
IT provides an agile platform that allows rapid reconfiguration to create innovative IT-enabled business capabilities.	○	○	○	○	○	○

	Strongly disagree				Strongly agree	I don't know
IT provides a platform that allows the integration of solution partners to enable the timely development and delivery of capabilities to support new offerings.	○	○	○	○	○	○

	Strongly disagree				Strongly agree	I don't know
IT provides a platform that allows leveraging cross-unit synergies across the firm for example through shared services.	○	○	○	○	○	○

The following statements aim to assess the role of IT in your firm.

Please select the statement that fits best with your firm's IT function.

Governance

- ○ IT has responsibility for technology and service innovation delivery and any projects initiated and is therefore to a large extent responsible for the firm's competitiveness.
- ○ Business and IT have joint responsibility for technology and service innovation delivery and projects.
- ○ IT has no own responsibility for technology and service innovation delivery and projects, but for the availability of Information systems and services.

Degree of Centralization

- ○ IT is centralized. One central IT department provides services with a single-access provision.
- ○ IT is decentralized. Several IT departments bring IT geographically closer to the user.
- ○ IT is federalized. IT is diffused regarding geography and management

IT cost structure

- ○ IT acts as a cost center, which does not produce direct profit and therefore adds to the cost of running an enterprise. (Meet target cost)
- ○ IT acts as a revenue center, which is responsible for its own revenue. (Generate revenue)
- ○ IT acts as a profit center, which is responsible for generating its own results and earnings. (Generate profit)
- ○ IT acts as an investment center, which accounts for all uses of capital. (Achieve value contribution)

You are almost done!

Please answer these last "control questions", which are important to categorize your previous answers.

In which Industry is your enterprise operating?
Please select one of the provided options:

[Please choose]

Please name your Industry

How big is your enterprise?
Please select the approximate number of employees.

- ○ Less than 50
- ○ 50 to 200
- ○ 201 to 500
- ○ 501 to 1000
- ○ 1001 to 10000
- ○ More than 10000

OPTIONAL: When was your enterprise founded?

Year:

Which organizational unit does your department belong to?
Please indicate your department (e.g. IT, Business Development, etc.)

Which position do you hold in your enterprise?
Please indicate your position

How long do you already work for your enterprise?

Number of years: [Please choose]

How old are you?

Age in years:

OPTIONAL: Please enter your email and you will receive the results of the study personally.

Email:

Seite 09
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Thank you for completing this questionnaire!

We would like to thank you very much for contributing to this research study.

Your answers were transmitted, you may close the browser window or tab now.

This survey is conducted by Detecon International GmbH in cooperation with the University of Gothenburg. For questions and further information please contact Klaus Schrenker.

Survey Data

Demographic Information

Demographics Table 1: Industry

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Automotive and suppliers	11	57,9	61,1	61,1
	High-tech	2	10,5	11,1	72,2
	Manufacturing	5	26,3	27,8	100,0
	Total	18	94,7	100,0	
Missing	Not answered	1	5,3		
Total		19	100,0		

Demographics Table 2: Firm Size

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 50	1	5,3	5,3	5,3
	1001 to 10000	2	10,5	10,5	15,8
	More than 10000	16	84,2	84,2	100,0
	Total	19	100,0	100,0	

Demographics Table 3: Respondents Position in the firm

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Asset & Liability Manager	1	5,3	5,9	5,9
	Business Development Engineer	1	5,3	5,9	11,8
	Department leadership	1	5,3	5,9	17,6
	EAM	1	5,3	5,9	23,5
	Enterprise Architect	1	5,3	5,9	29,4
	Manager	5	26,3	29,4	58,8
	Project Manager	2	10,5	11,8	70,6
	Senior Manager	4	21,1	23,5	94,1
	Senior Manager Customer Management	1	5,3	5,9	100,0
	Total	17	89,5	100,0	
Missing	Not answered	2	10,5		
Total		19	100,0		

Demographics Table 4: Organizational Unit of the respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Business Development	2	10,5	11,1	11,1
	Financial Services	1	5,3	5,6	16,7
	Innovation Management	1	5,3	5,6	22,2
	IT	8	42,1	44,4	66,7
	Operation	1	5,3	5,6	72,2
	Sales	4	21,1	22,2	94,4
	Strategy	1	5,3	5,6	100,0
	Total	18	94,7	100,0	
Missing	Not answered	1	5,3		
Total		19	100,0		

Demographics Table 5: Personal experience with PSS development

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	1	5,3	6,7	6,7
	2	1	5,3	6,7	13,3
	5	2	10,5	13,3	26,7
	10	3	15,8	20,0	46,7
	15	1	5,3	6,7	53,3
	20	5	26,3	33,3	86,7
	100	2	10,5	13,3	100,0
	Total	15	78,9	100,0	
Missing	Not answered	4	21,1		
Total		19	100,0		

Demographics Table 6: Respondent age in years

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	42	1	5,3	5,6	5,6
	43	1	5,3	5,6	11,1
	47	2	10,5	11,1	22,2
	50	4	21,1	22,2	44,4
	51	1	5,3	5,6	50,0
	52	3	15,8	16,7	66,7
	54	1	5,3	5,6	72,2
	56	2	10,5	11,1	83,3
	59	1	5,3	5,6	88,9
	62	1	5,3	5,6	94,4
	68	1	5,3	5,6	100,0
	Total	18	94,7	100,0	
Missing	Not answered	1	5,3		
Total		19	100,0		

Demographics Table 7: Years working in the firm

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4	1	5,3	5,6	5,6
	5	1	5,3	5,6	11,1
	6	1	5,3	5,6	16,7
	8	1	5,3	5,6	22,2
	9	1	5,3	5,6	27,8
	12	1	5,3	5,6	33,3
	15	1	5,3	5,6	38,9
	18	3	15,8	16,7	55,6
	20	1	5,3	5,6	61,1
	21	1	5,3	5,6	66,7
	24	2	10,5	11,1	77,8
	25	1	5,3	5,6	83,3
	28	2	10,5	11,1	94,4
	39	1	5,3	5,6	100,0
	Total	18	94,7	100,0	
Missing	Not answered	1	5,3		
Total		19	100,0		

Servitization Measures

Servitization Table 1: How important are PSS currently for your enterprise?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Moderately important	7	30,4	33,3	33,3
	Important	9	39,1	42,9	76,2
	Very important	5	21,7	23,8	100,0
	Total	21	91,3	100,0	
Missing	Not answered	2	8,7		
Total		23	100,0		

Servitization Table 2: How important will PSS become for your enterprise in the future?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Moderately important	1	4,3	4,8	4,8
	Important	4	17,4	19,0	23,8
	Very important	16	69,6	76,2	100,0
	Total	21	91,3	100,0	
Missing	Not answered	2	8,7		
Total		23	100,0		

Servitization Table 3: How important is service orientation in your current enterprises current policies, practices and procedures?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Moderately important	8	34,8	38,1	38,1
	Important	8	34,8	38,1	76,2
	Very important	5	21,7	23,8	100,0
	Total	21	91,3	100,0	
Missing	Not answered	2	8,7		
Total		23	100,0		

Servitization Table 4: How important will service orientation become for your enterprise in the future?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Important	6	26,1	28,6	28,6
	Very important	15	65,2	71,4	100,0
	Total	21	91,3	100,0	
Missing	Not answered	2	8,7		
Total		23	100,0		

Servitization Table 5: How important is the IT organization currently for developing PSS?

		Frequency	Percent	Cumulative Percent
	Of little importance	4	21,1	21,1
	Moderately important	8	42,1	63,2
	Important	3	15,8	78,9
	Very important	4	21,1	100,0
	Total	19	100,0	

Servitization Table 6: How important is the IT organization currently for delivering PSS?

		Frequency	Percent	Cumulative Percent
	Moderately important	7	36,8	36,8
	Important	5	26,3	63,2
	Very important	7	36,8	100,0
	Total	19	100,0	

Dynamic Capability Measures

Case Processing Summary for Dynamic Capabilities

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Dynamic Sensing Capabilities * Current Service Orientation	18	94,7%	1	5,3%	19	100,0%
Dynamic Seizing Capabilities * Current Service Orientation	17	89,5%	2	10,5%	19	100,0%
Dynamic Reconfiguring Capabilities * Current Service Orientation	17	89,5%	2	10,5%	19	100,0%

Crosstab 1: Dynamic Sensing Capabilities – Current Service Orientation

		Current Service Orientation			
		Moderately important	Important	Very important	Total
Dynamic Sensing Capabilities	Undecided	3	2	0	5
	Agree	4	3	3	10
	Strongly agree	0	2	1	3
Total		7	7	4	18

Directional Measures 1: Dynamic Sensing Capabilities – Current Service Orientation

			Value	Asymptotic Standardized Error[a]	Approximate T[b]	Approximate Significance
Ordinal by Ordinal	Somers' d	Symmetric	,360	,133	2,484	,013
		Dynamic Sensing Capabilities Dependent	,343	,136	2,484	,013
		Current Service Orientation Dependent	,379	,134	2,484	,013

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Crosstab 2: Dynamic Seizing Capabilities – Current Service Orientation

		Current Service Orientation			
		Moderately important	Important	Very important	Total
Dynamic Seizing Capabilities	Disagree	1	1	0	2
	Undecided	5	4	2	11
	Agree	1	0	1	2
	Strongly agree	0	1	1	2
Total		7	6	4	17

Directional Measures 2: Dynamic Seizing Capabilities – Current Service Orientation

			Value	Asymptotic Standardized Error[a]	Approximate T[b]	Approximate Significance
Ordinal by Ordinal	Somers' d	Symmetric	,267	,184	1,371	,170
		Dynamic Seizing Capabilities Dependent	,245	,175	1,371	,170
		Current Service Orientation Dependent	,295	,201	1,371	,170

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Crosstab 3: Dynamic Reconfiguring Capabilities – Current Service Orientation

		Current Service Orientation			
		Moderately important	Important	Very important	Total
Dynamic Reconfiguring Capabilities	Disagree	1	2	0	3
	Undecided	4	3	0	7
	Agree	2	2	3	7
Total		7	7	3	17

Directional Measures 3: Reconfiguring Capabilities – Current Service Orientation

			Value	Asymptotic Standardized Error[a]	Approximate T[b]	Approximate Significance
Ordinal by Ordinal	Somers' d	Symmetric	,275	,211	1,278	,201
		Dynamic Reconfiguring Capabilities Dependent	,275	,202	1,278	,201
		Current Service Orientation Dependent	,275	,220	1,278	,201

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Role of IT Measures

Frequency Table 1: Governance - Responsibility for service innovation projects and delivery

		Frequency	Percent	Valid Percent
Valid	IT is responsible	1	5,3	5,6
	Business and IT have joint responsibility	14	73,7	77,8
	IT has no own responsibility	3	15,8	16,7
	Total	18	94,7	100,0
Missing	Not answered	1	5,3	
Total		19	100,0	

Frequency Table 2: Controlling - Cost Structure of IT

		Frequency	Percent	Valid Percent
Valid	Cost center	15	78,9	83,3
	Revenue center	1	5,3	5,6
	Investment center	2	10,5	11,1
	Total	18	94,7	100,0
Missing	Not answered	1	5,3	
Total		19	100,0	

Case Processing Summary for Governance Degree of Centralization

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Governance: Degree of centralization* IT Importance PSS Development	18	94,7%	1	5,3%	19	100,0%
Governance: Degree of centralization * IT Importance PSS Delivery	18	94,7%	1	5,3%	19	100,0%

Crosstab 4: Governance Degree of Centralization – Importance of IT for PSS Development

		Importance of IT for PSS Development				
		Of little importance	Moderately important	Important	Very important	Total
Governance: Degree of centralization for IT portfolio decision	Centralized	1	2	0	0	3
	Decentralized	2	3	2	2	9
	Federalized	1	3	0	2	6
Total		4	8	2	4	18

Crosstab 5: Governance Degree of Centralization - Importance of IT for PSS Delivery

		Importance of IT for PSS Delivery			
		Moderately important	Important	Very important	Total
Governance: Degree of centralization for IT portfolio decision (Business Applications)	Centralized	3	0	0	3
	Decentralized	2	3	4	9
	Federalized	2	1	3	6
Total		7	4	7	18

Case Processing Summary for IT Vision

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Innovation Enabler Vision * IT Importance PSS Development	19	100,0%	0	0,0%	19	100,0%
Innovation Enabler Vision * IT Importance PSS Delivery	19	100,0%	0	0,0%	19	100,0%
Solution Integrator Vision * IT Importance PSS Development	19	100,0%	0	0,0%	19	100,0%
Solution Integrator Vision * IT Importance PSS Delivery	19	100,0%	0	0,0%	19	100,0%
Efficient Operator Vision * IT Importance PSS Development	19	100,0%	0	0,0%	19	100,0%
Efficient Operator Vision * IT Importance PSS Delivery	19	100,0%	0	0,0%	19	100,0%

Crosstab 6: Innovation Enabler Vision – Importance of IT for PSS Development

		Importance of IT for PSS Development				
		Of little importance	Moderately important	Important	Very important	Total
Innovation Enabler Vision	Disagree	3	2	0	0	5
	Undecided	1	4	0	1	6
	Agree	0	1	3	1	5
	Strongly agree	0	1	0	2	3
Total		4	8	3	4	19

Directional Measures 4 : Innovation Enabler Vision – Importance of IT for PSS Development

			Value	Asymptotic Standardized Error[a]	Approximate T[b]	Approximate Significance
Ordinal by Ordinal	Somers' d	Symmetric	,628	,128	4,567	,000
		Innovation Enabler Vision Dependent	,641	,127	4,567	,000
		IT Importance PSS Development Dependent	,617	,133	4,567	,000

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Crosstab 7: Innovation Enabler Vision – Importance of IT for PSS Delivery

		Importance of IT for PSS Delivery			
		Moderately important	Important	Very important	Total
Innovation Enabler Vision	Disagree	3	1	1	5
	Undecided	3	2	1	6
	Agree	0	2	3	5
	Strongly agree	1	0	2	3
Total		7	5	7	19

Directional Measures 5: Innovation Enabler Vision – Importance of IT for PSS Delivery

			Value	Asymptotic Standardized Error[a]	Approximate T[b]	Approximate Significance
Ordinal by Ordinal	Somers' d	Symmetric	,389	,194	2,010	,044
		Innovation Enabler Vision Dependent	,412	,206	2,010	,044
		IT Importance PSS Delivery Dependent	,368	,184	2,010	,044

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Crosstab 8: Solution Integrator Vision – Importance of IT for PSS Development

		Importance of IT for PSS Development				
		Of little importance	Moderately important	Important	Very important	Total
Solution Integrator Vision	Disagree	1	1	0	0	2
	Undecided	1	3	2	2	8
	Agree	2	3	1	1	7
	Strongly agree	0	1	0	1	2
Total		4	8	3	4	19

Directional Measures 6: Solution Integrator Vision – Importance of IT for PSS Development

			Value	Asymptotic Standardized Error[a]	Approximate T[b]	Approximate Significance
Ordinal by Ordinal	Somers' d	Symmetric	,097	,200	,479	,632
		Solution Integrator Vision Dependent	,094	,195	,479	,632
		IT Importance PSS Development Dependent	,100	,204	,479	,632

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Crosstab 9: Solution Integrator Vision – Importance of IT for PSS Delivery

		Importance of IT for PSS Delivery			
		Moderately important	Important	Very important	Total
Solution Integrator Vision	Disagree	2	0	0	2
	Undecided	3	3	2	8
	Agree	1	2	4	7
	Strongly agree	1	0	1	2
Total		7	5	7	19

Directional Measures 7: Solution Integrator Vision – Importance of IT for PSS Delivery

			Value	Asymptotic Standardized Error[a]	Approximate T[b]	Approximate Significance
Ordinal by Ordinal	Somers' d	Symmetric	,360	,204	1,754	,079
		Solution Integrator Vision Dependent	,361	,207	1,754	,079
		IT Importance PSS Delivery Dependent	,358	,202	1,754	,079

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Crosstab 10: Efficient Operator Vision – Importance of IT for PSS Development

		Importance of IT for PSS Development				
		Of little importance	Moderately important	Important	Very important	Total
Efficient Operator Vision	Disagree	1	1	1	1	4
	Undecided	1	4	1	2	8
	Agree	1	3	1	0	5
	Strongly agree	1	0	0	1	2
Total		4	8	3	4	19

Directional Measures 8: Efficient Operator Vision – Importance of IT for PSS Development

			Value	Asymptotic Standardized Error[a]	Approximate T[b]	Approximate Significance
Ordinal by Ordinal	Somers' d	Symmetric	-,118	,229	-,516	,606
		Efficient Operator Vision Dependent	-,117	,227	-,516	,606
		IT Importance PSS Development Dependent	-,119	,231	-,516	,606

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Crosstab 11: Efficient Operator Vision – Importance of IT for PSS Delivery

		Importance of IT for PSS Delivery			
		Moderately important	Important	Very important	Total
Efficient Operator Vision	Disagree	2	1	1	4
	Undecided	2	3	3	8
	Agree	2	1	2	5
	Strongly agree	1	0	1	2
Total		7	5	7	19

Directional Measures 9: Efficient Operator Vision – Importance of IT for PSS Delivery

			Value	Asymptotic Standardized Error[a]	Approximate T[b]	Approximate Significance
Ordinal by Ordinal	Somers' d	Symmetric	,065	,219	,298	,766
		Efficient Operator Vision Dependent	,067	,226	,298	,766
		IT Importance PSS Delivery Dependent	,063	,213	,298	,766

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Case Processing Summary for IT Mission

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Innovation Enabler Mission * IT Importance PSS Development	19	100,0%	0	0,0%	19	100,0%
Innovation Enabler Mission * IT Importance PSS Delivery	19	100,0%	0	0,0%	19	100,0%
Solution Integrator Mission * IT Importance PSS Development	19	100,0%	0	0,0%	19	100,0%
Solution Integrator Mission * IT Importance PSS Delivery	19	100,0%	0	0,0%	19	100,0%
Efficient Operator Mission * IT Importance PSS Development	19	100,0%	0	0,0%	19	100,0%
Efficient Operator Mission * IT Importance PSS Delivery	19	100,0%	0	0,0%	19	100,0%

Crosstab 12: Innovation Enabler Mission – Importance of IT for PSS Development

		Importance of IT for PSS Development				
		Of little importance	Moderately important	Important	Very important	Total
Innovation Enabler Mission	Disagree	2	1	0	0	3
	Undecided	2	5	1	1	9
	Agree	0	2	1	2	5
	Strongly agree	0	0	1	1	2
Total		4	8	3	4	19

Directional Measures 10: Innovation Enabler Mission – Importance of IT for PSS Development

			Value	Asymptotic Standardized Error[a]	Approximate T[b]	Approximate Significance
Ordinal by Ordinal	Somers' d	Symmetric	,578	,112	4,393	,000
		Innovation Enabler Mission Dependent	,563	,121	4,393	,000
		IT Importance PSS Development Dependent	,595	,111	4,393	,000

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Crosstab 13: Innovation Enabler Mission – Importance of IT for PSS Delivery

		Importance of IT for PSS Delivery			
		Moderately important	Important	Very important	Total
Innovation Enabler Mission	Disagree	2	1	0	3
	Undecided	4	2	3	9
	Agree	1	2	2	5
	Strongly agree	0	0	2	2
Total		7	5	7	19

Directional Measures 11: Innovation Enabler Mission – Importance of IT for PSS Delivery

			Value	Asymptotic Standardized Error[a]	Approximate T[b]	Approximate Significance
Ordinal by Ordinal	Somers' d	Symmetric	,425	,149	2,672	,008
		Innovation Enabler Mission Dependent	,429	,163	2,672	,008
		IT Importance PSS Delivery Dependent	,421	,139	2,672	,008

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Crosstab 14: Solution Integrator Mission – Importance of IT for PSS Development

		Importance of IT for PSS Development				
		Of little importance	Moderately important	Important	Very important	Total
Solution Integrator Mission	Disagree	1	1	0	0	2
	Undecided	2	3	2	1	8
	Agree	1	4	0	3	8
	Strongly agree	0	0	1	0	1
Total		4	8	3	4	19

Directional Measures 12: Solution Integrator Mission – Importance of IT for PSS Development

			Value	Asymptotic Standardized Error[a]	Approximate T[b]	Approximate Significance
Ordinal by Ordinal	Somers' d	Symmetric	,289	,161	1,724	,085
		Solution Integrator Mission Dependent	,273	,156	1,724	,085
		IT Importance PSS Development Dependent	,307	,167	1,724	,085

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Crosstab 15: Solution Integrator Mission – Importance of IT for PSS Delivery

		Importance of IT for PSS Delivery			
		Moderately important	Important	Very important	Total
Solution Integrator Mission	Disagree	2	0	0	2
	Undecided	3	3	2	8
	Agree	2	2	4	8
	Strongly agree	0	0	1	1
Total		7	5	7	19

Directional Measures 13: Solution Integrator Mission – Importance of IT for PSS Delivery

			Value	Asymptotic Standardized Error[a]	Approximate T[b]	Approximate Significance
Ordinal by Ordinal	Somers' d	Symmetric	,429	,173	2,342	,019
		Solution Integrator Mission Dependent	,420	,181	2,342	,019
		IT Importance PSS Delivery Dependent	,439	,167	2,342	,019

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Crosstab 16: Efficient Operator Mission – Importance of IT for PSS Development

		Importance of IT for PSS Development				
		Of little importance	Moderately important	Important	Very important	Total
Efficient Operator Mission	Disagree	1	1	1	1	4
	Undecided	2	3	1	2	8
	Agree	0	4	1	0	5
	Strongly agree	1	0	0	1	2
Total		4	8	3	4	19

Directional Measures 14: Efficient Operator Mission – Importance of IT for PSS Development

			Value	Asymptotic Standardized Error[a]	Approximate T[b]	Approximate Significance
Ordinal by Ordinal	Somers' d	Symmetric	-,047	,223	-,212	,832
		Efficient Operator Mission Dependent	-,047	,221	-,212	,832
		IT Importance PSS Development Dependent	-,048	,225	-,212	,832

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Crosstab 17: Efficient Operator Mission – Importance of IT for PSS Delivery

		Importance of IT PSS Delivery			
		Moderately important	Important	Very important	Total
Efficient Operator Mission	Disagree	2	1	1	4
	Undecided	2	3	3	8
	Agree	2	1	2	5
	Strongly agree	1	0	1	2
Total		7	5	7	19

Directional Measures 15: Efficient Operator Mission – Importance of IT for PSS Delivery

			Value	Asymptotic Standardized Error[a]	Approximate T[b]	Approximate Significance
Ordinal by Ordinal	Somers' d	Symmetric	,065	,219	,298	,766
		Efficient Operator Mission Dependent	,067	,226	,298	,766
		IT Importance PSS Delivery Dependent	,063	,213	,298	,766

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.