Managing servitization in product companies: the moderating role of service suppliers

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Abstract

Purpose – The purpose of this paper is to study service innovation in product companies (servitization) by considering the relationship (moderation) between product companies and service suppliers.

Methodology – Using a relational view of the firm, we propose that there are three main business dimensions that product companies have to manage in servitization and that the support of service suppliers can moderate the effects of these dimensions on the benefits obtained from the Product-Service System (PSS) delivered. To test these hypotheses, we perform a cross-sectional quantitative survey in 104 Brazilian and Italian product companies.

Findings – Our findings show that the three business dimensions are important for servitization while there is a trade-off decision regarding service suppliers’ involvement since suppliers act differently depending on the PSS orientation (product or service-oriented).

Research limitations/implications – Our work is limited to the analysis of what should change in a company during servitization and the impact of supplier’s support. Further research is needed to complement this study by analyzing the process and context of the organizational change.

Originality/value – This is one of the first quantitative studies to provide evidence of how service supplier’s support affects different servitization business dimensions and the obtained benefits for both product and service-oriented outputs.

Practical implications – Our research contributes an understanding about how the benefits practitioners can obtain from servitization are strongly influenced by the involvement of service suppliers and how this influence depends on the PSS orientation of the product company.

Keywords: Service supply chain; Servitization; Product-service system; Supplier involvement.
1 Introduction

Servitization is considered as a strategic business transformation from the traditional ‘pure’ product-centered offering to an integrated product and service value offering, often named as Product Service System (PSS) (Baines et al. 2009). This transformation brings new challenges for product companies (Alghisi & Saccani 2015), especially because they may lack knowledge about how to innovate in the service domain (Ayala et al. 2017). New Product Development (NPD) has traditionally been focused on technology capabilities to improve product components and systems (Marsh & Stock 2006), while service-related capabilities are frequently dismissed or neglected, being considered as something specific for the after-sales sector (Szweczyzewski et al. 2015). Observed from a relational view (Dyer & Singh 1998), instead of working alone to overcome the servitization challenge of integrating product and service domains, product companies can seek external support from firms with the necessary service knowledge and capabilities, named as service suppliers.

When considering the relationship between product companies, service suppliers and customers, some studies name this as a ‘service triad’ (Wynstra et al. 2015). The service triad has become a prominent topic within the operations management and supply chain management fields (Wynstra et al. 2015; Karatzas et al. 2016; Wuyts et al. 2015). However, the literature scarcely addresses the specific contribution of service suppliers with a focus on servitization (Karatzas et al. 2017; Bastl et al. 2012). Additionally, the literature is not clear to what extent this service supplier support is beneficial. Previous studies found several positive outcomes for product companies, such as more value added and greater internal flexibility (Bastl et al. 2012; Finne & Holmström 2013). Other studies also identified negative effects that could erode the results obtained from the PSS offer, such as higher complexity and knowledge leakages (Lockett et al. 2011; Davies et al. 2007).
As Eloranta and Turunen (2015) stated, servitization transition has traditionally been studied from an individual firm point of view while servitizing companies can gain more competitive advantages by facing this challenge from a relational theoretical view. Current literature shallowly answers questions such as to what extent product companies may be supported by service suppliers aiming for servitization and what is the outcome of such a relationship for servitization (Finne & Holmström 2013; Fleury & Fleury 2014; Saccani et al. 2014). Our systematic literature review (see Appendix A) summarizes the evidence for the lack of studies on this topic. The few studies in this field are mostly based on theoretical discussion or qualitative research. Theoretical validation based on quantitative research is scarce. Thus, there is not sufficient empirical evidence regarding the impact that service suppliers support can have for servitization.

The literature review (Appendix A) shows that the resource-based view and network positioning have been the dominantly explored theoretical lenses in this literature, while the specific focus on the the relational advantage of the cooperation with suppliers deserves more attention (Eloranta and Turunen, 2015). Finally, as far as the supply chain literature addresses the servitization issue, our systematic literature review (Appendix A) finds that the implications of the manufacturing business configuration have only been tangentially addressed, representing an important gap in this research field. Therefore, based on the demonstrated gaps, this paper addresses the following research question: Does the relationship of the product firm with service suppliers support the implementation of a business configuration focused on the servitization strategy?

To answer this research question, first, we identified in the literature three business dimensions that are relevant for the servitization implementation. Second, we investigated the possible moderating role of service suppliers in the relationship between the different business
dimensions of the servitization strategy and the benefits obtained by product companies. Since the expected benefits for a product company can differ according to its PSS orientation (Mathieu 2001a), we consider two groups of benefits, i.e. product-oriented and service-oriented PSS benefits. We investigated our research question by means of a quantitative survey with 104 Brazilian and Italian product companies. Our results show different (and some unexpected) effects of the servitization support of service suppliers for product companies.

2 Theoretical background and research hypotheses

2.1 Relational view theory and the servitization of product firms

Different theoretical perspectives have been used to analyze inter-organizational relationships in a pure product context (Palmatier et al. 2007; Mena et al. 2013) and in a PSS context (Karatzas et al. 2016; Eloranta & Turunen 2015). Such perspectives are network positioning, resource-based view of the firm, transaction cost economics, social exchange theory, relational view, among others. For this study, we adopt the relational view theoretical lens (Dyer & Singh 1998), which has only been used tangentially in the specific servitization literature, as we show in our systematic review of the literature (Appendix A).

The relational view argues that firms can achieve above-normal benefits when working in relationship with other firms. In this view the unit of analysis is not a single firm but a dyad or even a network of firms (Dyer & Singh 1998). The relational view is an extension of the (internal) resource-based view and dynamic capabilities of the firm (Eloranta & Turunen 2015). In this sense, instead of considering only outsourcing activities for economic rents, the relational view considers that the firm can also obtain internal gains by the support of the external partners (Dyer & Singh 1998). By collaborating with external partners, manufacturing firms can increase inter-firm knowledge sharing resulting in an improvement of the internal
business development, especially when the manufacturer seeks the support of external service suppliers to increase servitization knowledge and service operation capacity (Ayala et al. 2017; Mathieu 2001b). Furthermore, servitization advantages can be obtained due to inter-firm specific assets, complementary resource endowments and effective governance. These potential sources of rent should be built on the base of trust between parties (Dyer & Singh 1998; Nordin 2008).

We chose the theoretical relational view perspective since our aim is to verify whether there are above-normal benefits (i.e. more benefits than those expected without the external relationship) for the product company when it receives the support of service suppliers (Dyer & Singh 1998). Thus, we follow this theoretical perspective which has been also used in the classical NPD literature, when supplier performance was measured in relation to co-design activities (Le Dain et al. 2011). It is well known in the servitization literature that, due to the complexity of PSS offerings, product companies are frequently forced to complement their capabilities with those of other firms (Spring & Araujo 2013). Thus, many authors argue that competitive advantage from servitization is not mainly an outcome of individual firms’ actions, but originates from – at least – a dyadic relationship of product companies and service providers (Finne & Holmström 2013; Eloranta & Turunen 2015; Ayala et al. 2017). However, this relationship is not always based on trust as expected in the relational view (Dyer & Singh 1998; Nordin 2008). In many cases, the product company can establish a cooperation with service suppliers based on an opportunity and due to the lack of knowledge regarding service development and delivery. In such cases, the product firm may use this relationship as a first step before developing its internal service capabilities. This strategy can produce a negative effect on the expected benefit of the servitization relationship (Ayala et al. 2017).
When considering the state-of-the-art in the literature (Appendix A), it is worth noticing that He and Lai (2012) is the only identified study that adopted a quantitative validation perspective to investigate the relational view between servitized companies and their suppliers (although the suppliers are treated in a general sense and not specifically as service suppliers). As this study showed, operational integration of the supply chain has a positive direct effect on a product-based service, while strategic integration has a positive direct effect on a customer action-based service. Unfortunately, the more recent literature has not advanced further in understanding additional effects of such a relationship. Therefore, we focus with our study on the internal business configuration effects and benefits when product companies receive support from service suppliers, which is one of the concerns of the relational view (Dyer & Singh 1998). By analyzing different business dimensions, we aim to verify different relational effects. We try to show that dyadic relationships should not only be treated as something generic, but that their contributions and impacts for various dimensions of the business can be different, deserving more attention in terms of formulating the strategy of such a cooperation.

2.2 PSS benefits and orientations

There are several suggestions in the literature claiming that servitization can lead to a wide range of benefits for product companies (e.g. Chesbrough 2011; Lindahl et al. 2014). Nevertheless, the benefits that can be expected by product companies depend on their respective servitization strategy and the orientation of the company’s PSS (Matthyssens & Vandenbempt 2010; Kapletia & Probert 2010). We follow for investigating this aspect Ayala et al. (2017) who considers two types of PSS orientation: product-oriented PSS and service-oriented PSS. In the first case, product companies are more focused on finding as many users and customers as possible for their products (Galbraith 2002). Furthermore, product companies are using the services to extend products and support their usage (Kowalkowski et al. 2017;
Cusumano et al. 2015), as for instance by maintenance, delivery of spare parts or product-upgrade. In the second focus (service-oriented PSS), product companies are customer-centered and the offered solutions may not be restricted by the product itself. Product companies use the offered services mainly to support customers’ activities (Kowalkowski et al. 2017). This approach usually leads to a highly customized solution that requires a significant level of customer involvement including potential changes in product design or the way products are offered (Cusumano et al. 2015). Some examples for such customized services are the offering of optimization solutions instead of simple equipment or the sale of a product as a service, focusing on the results produced for the customers.

As Ayala et al. (2017) and Kowalkowski et al. (2015) stated, a product company can have different PSS orientations within its portfolio and the benefits expected from each orientation are different. In terms of product-oriented PSS benefits, the product company delivers services expecting to leverage the sales of the products to its existing customers and to use the knowledge collected from service delivery to develop new products (Kowalkowski et al. 2017; Mathieu 2001b). Furthermore, the company uses services as a mean of reaching new customers and markets with its existing products (Raddats et al. 2016; Gebauer et al. 2011). Thus, regarding the product-oriented benefits, the focus is the company’s products which can benefit from the service offering. Concerning service-oriented PSS benefits, the product company expects to retain customers by creating loyalty and delivering novelty (Vandermerwe & Rada 1988; Santamaría et al. 2012) through solutions that are adapted to its customers’ needs and requirements for more added value (Raddats et al. 2016; Matthyssens & Vandenbempt 2010). In this case, the focus is not the product development process itself, but the broader capacity of the product company to offer services, not restricted to its existing products but following the customer needs.
In this context it is important to highlight that there are potential additional benefits from servitization that we do not address in our study, since they are consequences of both PSS orientations. Some of them are: possible higher profit margins, stable incomes and revenues, and stronger differentiation from competitors (Mathieu 2001b; Gebauer et al. 2011; Suarez et al. 2013).

2.3 Structuring the business dimensions to support servitization

Product companies heading towards servitization must face an internal business transformation in order to develop the resources needed to achieve the potential benefits (Baines & Shi 2015). Prior research addresses different structural changes that are necessary to implement servitization (e.g. Gaiardelli et al., 2014; Rabetino et al. 2015). Bigdeli et al. (2017) adapted some propositions from strategic change literature to the specific context of servitization implementation. They suggested that a company needs to consider three main aspects for implementing such a transformation: the content of a chosen strategy, i.e. what changes; the process of change which reveals various content alternatives, i.e. how it changes; and the context in which the company’s change occurs, i.e. why it changes. Following a relational view perspective, we focus our attention specifically on the content of the change through external relationship with service suppliers, i.e. what business dimensions of the servitization strategy can be supported by service suppliers as element of the servitization strategy implementation.

In a general sense, the literature addresses three main dimensions of this change (e.g. Böhm et al. 2017; Gebauer et al. 2012; Santamaría et al. 2012; Wit & Meyer 2010): (i) Service offering – i.e. which focus should the product company adopt, which in our context is the focus on the development of the servitization strategy; (ii) Resource base – i.e. what conditions are required, i.e. the internal conditions regarding intellectual resources such as knowledge, skills and capabilities; and (iii) Activity system – i.e. which activities should be performed,
considering activities and organizational arrangements to operationalize the servitization strategy. Next, we discuss these dimensions and propose our hypotheses regarding their impact on the benefits of each PSS orientation.

### 2.3.1 Service offering dimension for servitization

We define the ‘service offering’ dimension of servitization in a business system as the service-based conditions under which a product company offers value to its customers. That means that the strategic vision regarding intangible resources of a product company should develop in order to offer a PSS (Böhm et al. 2017; Gebauer et al. 2012; Santamaría et al. 2012; Wit & Meyer 2010). Referring to this dimension the competitive advantage due to servitization is based on the company’s understanding of how the additional service value is perceived by customers and on the ability to offer sustainable solutions to meet their expectations (Gaiaardelli et al. 2014). This competitive advantage transforms services into direct enhancers of the tangible products’ value (Windahl & Lakemond 2010; Mathieu 2001b). The delivery of additional value concerning the offering leads to more satisfied customers (Lockett et al. 2011). Moreover, a servitization strategy can be used to enhance information sharing through the interaction with customers, allowing companies to rapidly respond to their customers’ needs with new products (Baines et al. 2017; Cusumano et al. 2015). Thus, we propose Hypothesis 1:

\[ H1: \text{The development of a service offering business dimension for servitization is associated with higher service-oriented (H1a) and product-oriented (H1b) benefits for product companies.} \]

### 2.3.2 Resource base dimension of servitization

The second dimension, named ‘resource base’, refers to what should change in a firm related to the human assets, such as individual expertise, competences, knowledge and flexibility, in
order to be able to deal with the PSS offering (Böhm et al. 2017; Gebauer et al. 2012; Santamaría et al. 2012; Wit & Meyer 2010). New strategic orientation towards servitization requires a structural change of the product company (Kreye et al. 2015). The company needs to reframe its human resources to deal with new dynamic product and service market conditions, which demands greater internal flexibility (Matthyssens & Vandenbempt 2010; Neu & Brown 2008). New service offerings usually require a development of new corporate competences (Brax & Jonsson 2009). Human capital and knowledge become a main source of competitive advantage due to the fact that service offering implies dealing directly with the customer and with problem-solving situations, resulting in a higher solution variability (Tuli et al. 2007; Baines et al. 2009). In addition, employees who are involved in service activities must be proactive. They need to have more inter-personal flexibility and they must be more sensitive on average than employees who work with products (Barnett et al. 2013). Moreover, product companies that are following a servitization strategy may have to deal with further significant challenges such as cultural issues due to fundamental changes in the organizational structure or limitations of employees’ knowledge about the offering (Mont 2002). Thus, when product companies make efforts to enhance their resource base to actively address these challenges, we expect that they obtain more benefits from PSS delivery, regardless of their orientation.

Consequently, we propose Hypothesis 2:

\[ H2: \text{The development of a resource base business dimension for servitization is associated with higher service-oriented (H2a) and product-oriented (H2b) benefits for product companies.} \]

2.3.3 Activity system for servitization

The third dimension of a business system in our study is the ‘activity system’ which is defined in the servitization context as the internal organizational processes of the company to develop
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a PSS offering (Böhm et al. 2017; Gebauer et al. 2012; Santamaria et al. 2012; Wit & Meyer 2010). This definition considers various operational aspects that a product company must conduct. One of these aspects is the integration of resources and functional processes (whether in different teams, departments or other units) (Tuli et al. 2007). Concerning this aspect, Paslauski et al. (2016) demonstrated that the integration of after-sales support and engineering as well as the development of knowledge transfer activities among other functional areas involved in the servitization process (e.g. product and marketing) is essential for the success of the PSS solution. Another important aspect of this operationalization is the level of customization of the solution package (Durugbo & Riedel 2013; Mont 2002). Frequently, a more customized solution is associated with more satisfied customers, since it requires a stronger proximity to and interaction with them. A customized solution package demands the development of an interface team and of processes to bridge the internal development of the product company with the external requirements of the market (Kindström & Kowalkowski 2009). Most product companies start their servitization process with a standardized solution package (e.g. after-sales services) and move after the beginning of the transformation process towards a more customized solution with additional value for the customer (Cusumano et al. 2015; Matthyssens & Vandenbempt 2010). This approach can imply the joint design of products and services by company and customer for the co-creation and delivery of value that lever customer loyalty and attracts new customers (Durugbo 2014). All these abovementioned activities may be required independently of the company’s choice regarding the delivery of a product-oriented PSS or a service-oriented PSS, which leads us to propose Hypothesis 3:

**H3**: The development of an activity system business dimension for servitization is associated with higher service-oriented (H3a) and product-oriented (H3b) benefits for product companies.
The proposed hypotheses regarding the direct effect of the three business dimensions on servitization benefits are relevant for the literature because some prior studies reported negative results (financial and non-financial) of the servitization implementation in product companies (Gebauer et al. 2005; Fliess & Lexutt 2017; Bigdeli et al. 2017). The risk of an unsuccessful servitization usually increases when product companies need to rearrange their business structure and to develop new internal resources to support their new business strategy (Benedettini et al. 2015). Therefore, before we analyze the role of service suppliers to support the servitization implementation, we first discussed such direct effect of the business dimensions.

2.4 The moderating role of service suppliers

Service suppliers’ support appears as an alternative for product companies to overcome the barriers and challenges of the servitization journey (Alghisi & Saccani 2015; Raddats et al. 2017). The relationship with suppliers allows access to previously unavailable resources (Bastl et al., 2012). The strategic goal of such a support for product companies can either be to have access to the service supplier’s unique resources or to outsource the service part (Van der Valk & Van Iwaarden 2011; Karatzas et al. 2017). Ayala et al. (2017) adapted Petersen’s et al. (2005) classification of buyer-supplier relationship in NPD projects for the servitization context, resulting in three different forms of how a product company can be supported by a service supplier aiming at the development and offer of PSS solutions. These different forms are: (i) the product company designs almost the entire PSS solution alone, but the delivery of the service part is outsourced to the service supplier; (ii) the product company outsources all the development and delivery of the service part of the PSS solution to the service supplier; and (iii) both companies work together along the co-designed process of the PSS solution. The product company may decide between these different types of relationship configurations.
according to each product’s characteristics and strategic decisions (Ayala et al. 2017). Nevertheless, this decision could directly affect the way internal servitization-related business dimensions are structured. Consequently, it is important to study the influence of these different forms of service supply on the benefits obtained by product companies from servitization for each business dimension (Gebauer et al. 2013; Johnson & Mena 2008; Saccani et al. 2014).

Regarding the service offering dimension, the product company can be restricted by its own limited understanding of the new business opportunities and the possible new value proposition for customers. Consequently, external service companies that understand their potential contribution to the PSS offering can help to enhance the product company’s vision of the crucial additional value which should be offered (Lockett et al. 2011). Hence, the cooperation between product companies and service suppliers can result in a stronger customer orientation of the offered PSS solution (Bastl et al. 2012). Furthermore, with the support of service partners, companies are often better able to complement or increase the functionalities of their own product with the aims of leveraging sales and reaching new customers (Finne & Holmström 2013; Raddats et al. 2017). Therefore, we propose the following Hypothesis 4.

\[ H4: \text{The relationship with service suppliers to support servitization positively moderates the association of the service offering dimension on both service-oriented (H4a) and product-oriented (H4b) servitization benefits for product companies.} \]

In addition, the support of suppliers may affect the resource base dimension of the business system, since companies pursuing servitization must decide between developing all service capabilities internally or delegate them to suppliers. This decision is similar to the ‘make or buy’ product decision (Paiola et al. 2013), although the internal development of service capabilities can be difficult for product companies because of the overall lack of knowledge regarding service processes (Bustinza et al., 2010; Raddats et al. 2017). During a collaboration
with service suppliers the product company can smoothly develop the required new capabilities in its own human assets by absorbing knowledge from the service suppliers (Matthyssens & Vandenbempt 2010; Neu & Brown 2008). The collaboration with service suppliers can in this way provide essential skills for the company that would be unavailable without such a partnership (Raddats et al. 2017). Intense contribution of suppliers’ knowledge and capabilities may provide greater internal flexibility, since the product company can adapt more easily to the markets’ demands by reconfiguring its relationships with those service suppliers that can help to address the required challenges (Finne & Holmström 2013). Thus, we conclude with Hypothesis 5:

\[ H5: \text{The relationship with service suppliers to support servitization positively moderates the association of the resource base dimension on both service-oriented (H5a) and product-oriented (H5b) servitization benefits for product companies.} \]

Finally, regarding the activity system, the complexity of the processes to develop and deliver product-service solutions can push product companies to partnerships with external service suppliers, since these companies often lack competences on the operational level (Meier et al. 2010). Many product companies fail in service operations because they lack operational expertise in this hybrid field (Turunen & Finne 2014). Particularly, the ability to offer different types of services in the solution, i.e. different levels of customization, can be strongly supported by service suppliers (Bastl et al. 2012; Brax & Visintin 2016). Furthermore, in a product-oriented PSS the support of a service supplier in the activity system dimension can increase the benefits for the product company by facilitating the introduction of new services related to the company’s products (Raddats et al. 2017). In a service-oriented PSS the support of a service supplier with a high degree of knowledge can enable new business model developments which
provide superior additional value for the customer compared to, e.g., business models with performance-based contracts (Ayala et al., 2017). Therefore, we can formulate Hypothesis 6:

\[ H6: \text{The relationship with service suppliers to support servitization positively moderates the association of the activity system dimension with both service-oriented (} H6a \text{) and product-oriented (} H6b \text{) servitization benefits for product companies.} \]

The model shown in Figure 1 summarizes our proposed hypotheses for the direct effects of the three business dimensions (H1, H2 and H3) on both product-oriented and service-oriented PSS benefits as well as the moderating effects of service suppliers in such associations.

As stated above, prior studies indicate a positive moderation of service suppliers regarding the benefits product companies can obtain from servitization. However, some authors have also demonstrated their concern about including suppliers in the servitization process. For instance, the risk of ‘knowledge leakage’ and the threat of opportunism while working with suppliers can influence companies to protect themselves, resulting into a less developed PSS solution (Lockett et al. 2011; Cook et al. 2006; Bigdeli, Bustinza, et al. 2017). Moreover, when the
service offering is the most valuable part of the PSS solution, the product company can lose proximity to its customers due to the intermediation of the service supplier, which might result in a weakened strategic position of the product company in the supply chain (Lockett et al. 2011; Ellram et al. 2008). In addition, the high complexity of working with service suppliers in a PSS delivery can be a threat for servitization success (Davies et al. 2007; Paiola et al. 2013). Thus, these potential negative influences of service suppliers’ support require testing the moderation effect of these actors, as proposed in our set of hypotheses.

3 Research Method

3.1 Sampling

To investigate the proposed hypotheses, we performed a cross-sectional international survey in product companies that offer service solutions in their portfolios. We obtained our sample from two industrial research networks in the field of servitization, one in Brazil and coordinated by two federal universities as well as another one in Italy and coordinated by a public university. The Brazilian sample is composed by 347 companies from the Southern region and the Italian sample is composed by 216 companies from the Northern region. The questionnaire was addressed to the representatives of the companies in the research networks who are all operations executives. We obtained a total of 213 answers (148 Brazilian and 65 Italian). However, concerning the variables used in this study only 104 of the received questionnaires were complete (response rate of 18.47%). Table 1 shows the composition of the sample.
TABLE 1: Sample composition (n = 104 companies)

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Quantity</th>
<th>Category</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
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<td>Company’s size</td>
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<tr>
<td></td>
<td>Construction</td>
<td>9</td>
<td>Medium (100-500 employees)</td>
<td>21</td>
<td></td>
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<tr>
<td></td>
<td>Metallurgical</td>
<td>8</td>
<td>Large (&gt;500 employees)</td>
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<td>Italy</td>
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<td></td>
<td>Furniture</td>
<td>7</td>
<td>Brazil</td>
<td>61</td>
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<td>79</td>
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<tr>
<td></td>
<td>Hardware (IT)</td>
<td>7</td>
<td>B2C</td>
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<tr>
<td></td>
<td>Others (&lt;3 by industry)</td>
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<td>More products than services</td>
<td>85</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>More services than products</td>
<td>19</td>
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3.2 Operationalization of variables and questionnaire

Regarding the dependent and explanatory variables of our study, we represented them in constructs which are composed of multiple-item scales. Since there is little prior research on quantitative aspects of servitization (Kowalkowski et al. 2017) as well as regarding the specific characteristics of a product company’s relationship with service suppliers (see Appendix A), we created new multi-item scales following the procedures and techniques suggested by Churchill (1979) to assure a reliable instrument. First, we defined the domain of each construct by an in-depth literature review (Appendix A). Furthermore, each construct was defined by analyzing several authors, as presented in Table 2 and described below. We contrasted the outcome of the systematic literature review with the information obtained from 23 interviews which we performed with professionals from 7 companies. These professionals are engaged in PSS solutions supported by service suppliers and helped us to refine the items which we derived from the literature. After the definition of the elements in each construct, we conducted a round of reviews with 7 academics (3 postdoctoral research fellows and 4 associate professors) from three institutions. Each participant was chosen based on the expertise in the field of servitization and PSS. Following this academic review, we reconsidered and adapted some
items, while others were removed to better represent the objective of each construct (e.g. solution customization was initially included in the ACTIVITY construct, but it was eliminated since it was considered by the reviewers to be out of the scope compared to the other items of this construct). Finally, the survey instrument was individually submitted for a test with three professionals to obtain their feedback regarding clarity of the questions. Due to this feedback, some wording was modified to avoid misunderstanding. We summarize in the following paragraphs the final construction and main literature references for each construct.

The service offering [OFFERING] dimension considers strategic elements that are necessary in a business configuration for servitization (Section 2.3.1). With this aim, we developed five items based on the competitive differentiation and customer satisfaction dimensions of Bustinza’s et al. (2015) survey and on the service differentiation dimension of Gebauer’s (2008) survey.

In the resource base [RESOURCE] construct we considered the internal intellectual assets required for the product company’s business model change towards servitization (Section 2.3.2). For measuring this construct, we developed a four-item scale inspired by Story’s et al. (2017) and Valtakoski’s (2017) theoretical frameworks. Story et al. (2017) suggested manufacturers’ internal capabilities required for servitization and Valtakoski (2017) contributed the idea that knowledge base aspects also are required for servitization. We use the thoughts of these authors to analyze in the RESOURCE construct aspects related to knowledge, expertise, capabilities and flexibility in regards to change (Table 2).

The activity system [ACTIVITY] considers the operational elements needed in the manufacturing business to allow a servitization (Section 2.3.3). This construct is based on the need for internal organization of the company’s structure and processes (Bustinza et al. 2015; Raja et al. 2018). The five-item scale for this construct was inspired mainly by Raddats and
Kowalkowski's (2014) as well as Paslauski's et al. (2016) questionnaire items that measure the need for integration and involvement of different areas, so that the company can operationalize the service development and delivery. Thus, this construct considers the overall integration of product and services processes (with focus on integrated PSS) and the involvement of different corporate fields: service area with NPD area, other functional areas, customer integration and further business units integration. Summarizing, this construct considers all aspects that could be integrated in product companies aiming at the operationalization of the servitization strategy.

For the service suppliers support [SERV_SUPP] construct we applied a relational perspective, according to the theoretical lens used in this paper. Thus, we focus on different types of relationships which a company can establish with its suppliers. We followed Ayala’s et al. (2017) adaptation of Petersen’s et al. (2005) typology that considers different types of relationships with suppliers. These types of relationships consider different levels of responsibility of the supplier: no supplier involvement, white box (service design driven by the product company while the service delivery is executed by the supplier), grey box (joint design of the product-service solution) and black box (service solution is designed by the supplier, i.e. service design outsourcing). We developed four items for these different types of relationships and included an additional item regarding a general view of the product company concerning the supplier support for the PSS solution (Ayala et al., 2017). Thus, we developed a composite scale (formative) of five items, considering different forms of relationships that product companies can adopt to receive support of service supplier.

Finally, we measured the two dependent variables product-oriented PSS benefits [P-O_BENEF] and service-oriented PSS benefits [S-O_BENEF] for product companies with a multiple-item scale that considers the overall service contribution based on four different items.
for each construct (Table 2). We applied this measurement following Visnjic et al. (2016) who suggested that product companies can have two different servitization focus – product-oriented or service-oriented – depending on whether the focus is on the services to increase the product value or the services to increase customer-value, respectively. Since the same company can have different servitization orientations within its PSS portfolio, we did not stratify the companies according to this topic. Both constructs were adapted from marketing and product innovation literature (Appendix A). We adapted the items for the *product-oriented benefits* construct to the servitization context based on some of the items used by Barczak et al. (2007) and Lau et al. (2011) for product market performance. Two of these items are focused on benefits for new products (enhanced development and sales) and two others focus on benefits for existing products (achievements in terms of of new customers and new markets). Both types of benefits are relevant for products based on a service offering. We adapted the items for the *service-oriented benefits* construct from customer orientation performance metrics used by Hennig-Thurau and Klee (1997), Langerak et al. (2004) and He & Lai (2012). In this last reference we considered specifically items from the customer action-based services construct which was studied by these authors in the context of servitization in supply chains.

We measured all items of the dependent and explanatory constructs using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). All the used variables and references are summarized in Table 2 and the complete questionnaire is available in Appendix B. After the data collection, we validated the scales by means of a Confirmatory Factor Analysis (CFA) and Cronbach’s Alpha analysis. Table 3 shows the final coefficients of the CFA.
We included control variables in our regression models for servitization performance following Paslauski et al. (2016). First, we considered firm size with two dummies for three main levels, following the Brazilian government definition: small (<100 employees), medium (100 to 500 employees) and large (>500 employees). We used this approach because the implementation of a servitization strategy is a form of business innovation which is reported in the literature as affected by companies’ size (Baines et al. 2017). Second, we included the business focus

### TABLE 2: Items of the scales

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Main concept of the question (item)</th>
<th>Main references used for the construct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Offering [OFFERING]</td>
<td>Service as a competitive advantage&lt;br&gt;Differentiation by services&lt;br&gt;Service to meet customers’ needs&lt;br&gt;Value added by services&lt;br&gt;Customer orientation</td>
<td>(Bustinza et al. 2015; Gebauer 2008)</td>
</tr>
<tr>
<td>Resource Base [RESOURCE]</td>
<td>Internal development of new competences&lt;br&gt;Individual expertise for service offering&lt;br&gt;Internal knowledge related to services processes&lt;br&gt;Internal flexibility</td>
<td>(Story et al. 2017; Valtakoski 2017)</td>
</tr>
<tr>
<td>Activity System [ACTIVITY]</td>
<td>Joint development of products and services&lt;br&gt;Involvement of service area in the NPD process&lt;br&gt;Involvement of functional areas in solution development&lt;br&gt;Involvement of customers in solution development&lt;br&gt;Involvement of other BU in solution development</td>
<td>(Paslauski et al. 2016; Raddats &amp; Kowalkowski 2014; )</td>
</tr>
<tr>
<td>Service Suppliers’ Support [SERV_SUPP]</td>
<td>Complete outsourcing of services&lt;br&gt;Complete internal development of services (inverse scale)&lt;br&gt;Internal design of services and outsourced delivery&lt;br&gt;Complementary competences of partners&lt;br&gt;Active supplier participation</td>
<td>Petersen et al. (2005) adapted by Ayala et al. (2017)</td>
</tr>
<tr>
<td>Product-oriented benefits [P-O_BENEF]</td>
<td>Service contribution for new product sales&lt;br&gt;Service contribution for new product development&lt;br&gt;Service contribution to access new customers with extant products&lt;br&gt;Service contribution to access new markets with extant products</td>
<td>(Barczak et al. 2007; Lau et al. 2011)</td>
</tr>
<tr>
<td>Service-oriented benefits [S-O_BENEF]</td>
<td>Service contribution to customer loyalty&lt;br&gt;Service contribution to adapt products to customers’ needs&lt;br&gt;Service contribution to innovation&lt;br&gt;Service contribution to value added to customers</td>
<td>(Langerak et al. 2004; Hennig-Thurau &amp; Klee 1997; He &amp; Lai 2012)</td>
</tr>
</tbody>
</table>
We considered this second variable because the types and the promptness of service offerings may vary depending on if the business (product company) is focused on other business companies or on final customers (Tukker 2015). Moreover, since our sample is composed of companies from two countries, one developed economy and one emergent, we included country as a third control variable (Italy = 0; Brazil = 1). Finally, we also used the percentage of portfolio distribution of product and service offerings to consider whether the company is more oriented towards products or services (Baines et al. 2009). Because we are only interested in servitized companies, we discarded companies with absolute scales (only product or service offering).

### 3.3 Sample and method variance

Firstly, we tested potential sample bias using Levene's test for equality of variances and a t-test for the equality of means between early and late respondents for the two samples (Brazil and Italy). The results of these tests indicated no differences in means and variation in the two groups and, consequently, no evidences for a significant difference compared to the population (Armstrong & Overton 1977).

Regarding the common method variance, we used several techniques suggested by Podsakoff et al. (2003) to reduce this risk. We randomized the questions’ order to avoid that the respondent may directly associate variables. Furthermore, we sent our questionnaire to key respondents. Finally, we calculated the Harman’s single-factor test with an exploratory factor analysis to address common method bias (Podsakoff et al. 2003). This test with all independent and dependent variables resulted into a first factor that comprehended only 19% of the observed variance. Since there was no single factor accounting for the majority of the variance in the model, this test indicates that common method bias may not be a problem for our sample.
However, we cannot conclude the absence of common method variance, since we deal with single respondents for each company (Guide and Ketokivi, 2015). We have taken all possible precautions, but there is still an innate limitation of our survey.

### 3.4 Measure validity and reliability

For the multi-item reflective constructs (RESOURCE; ACTIVITY; OFFERING, P-O_BENEF and S-O_BENEF) we validated unidimensionality by means of a confirmatory factor analysis (CFA) with STATA 13.0. This test indicates a good fitness of each proposed multi-item construct (OFFERING: CFI = 0.979; RMSEA = 0.067; RESOURCE: CFI = 0.996; RMSEA = 0.036; ACTIVITY: CFI = 0.996; RMSEA = 0.024; P-O_BENEF: CFI = 0.998; RMSEA=0.034; S-O_BENEF: CFI = 0.994; RMSEA=0.048). All items strongly loaded on their constructs (factor loading p-value < 0.01) in the inputs and outputs models. The construct reliabilities were all higher than 0.7.

We also tested discriminant validity based on Bagozzi et al. (1991) who suggested a series of two-factor model estimations. We performed two CFA models for each construct and compared their respective goodness of fit. In the first model, we restricted the correlation between the two constructs to unit, while in the second model we freed this restriction and calculated the goodness of fit for the original constructs. In this test the overall results showed discriminant validity ($\Delta \chi^2 > 3.84$, p-value < 0.05) (Bagozzi et al., 1991).

Table 3 shows the correlation matrix, means and standard deviations regarding our analyses. This table also summarize the composite reliability and Cronbach’s alpha values.
3.5 Data analysis

For the data analysis we used ordinary least square (OLS) regression which was calculated in Stata 13.0®. To test the moderation effects (H4a,b; H5a,b and H6a,b) we standardized the independent and moderating variables using a mean-centering (Z-score) and created a multiplicative score for the interaction effect (multiplying the moderator by each independent variable). We tested to confirm the assumptions of normality, linearity and homoscedasticity for all independent and dependent variables using the residuals, plots of partial regression and plots of standardized residuals against the predicted value, respectively (Hair et al. 2009). All these tests confirmed the required assumptions for OLS regression models.

4 Results

Our regression results are shown in Table 4. The three models with product-oriented PSS benefits as dependent variable (only controls, addition of direct effects and addition of moderating effect respectively) presented statistical inference. The final model, which contains the direct and moderating variables, is statistically significant (F-value = 9.87, p-value < 0.01) and explains 51% of the variance of the dependent variable (adjusted $R^2 = 0.51$). Additionally, there is only a differentiation of the country as control variable, showing in the complete
regression model that the Brazilian sample (control =1) obtained higher benefits (B=0.319, p<0.05). Regarding the regression models with service-oriented PSS benefits as dependent variable, the final regression model, which contains the direct and moderating variables, is statistically significant (F-value = 13.68, p-value < 0.01) and explains 59% of the variance of the dependent variable (adjusted $R^2 = 0.59$). The control variables were not significant for service-oriented models.

**TABLE 4: Hierarchical regression analysis for Service-Oriented and Product-Oriented PSS Benefits**

<table>
<thead>
<tr>
<th></th>
<th>Service-oriented PSS Benefits</th>
<th>Product-oriented PSS Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 1</td>
<td>Model 2</td>
</tr>
<tr>
<td>Control 1: Country</td>
<td>0.033</td>
<td>0.065</td>
</tr>
<tr>
<td>Control 2: Size_Large</td>
<td>-0.183</td>
<td>-0.152</td>
</tr>
<tr>
<td>Control 3: Size_Middle</td>
<td>-0.184</td>
<td>-0.271</td>
</tr>
<tr>
<td>Control 4: Business Focus</td>
<td>-0.294</td>
<td>0.030</td>
</tr>
<tr>
<td>Control 5: Portfolio</td>
<td>-0.31</td>
<td>-0.007</td>
</tr>
<tr>
<td>OFFERING</td>
<td>0.380***</td>
<td>0.382***</td>
</tr>
<tr>
<td>RESOURCE</td>
<td>0.152**</td>
<td>0.164***</td>
</tr>
<tr>
<td>ACTIVITY</td>
<td>0.205**</td>
<td>0.186**</td>
</tr>
<tr>
<td>SERV_SUPP</td>
<td>-0.112**</td>
<td>-0.125**</td>
</tr>
<tr>
<td>SERV_SUPP X OFFERING</td>
<td>-0.112**</td>
<td></td>
</tr>
<tr>
<td>SERV_SUPP X RESOURCE</td>
<td>0.09</td>
<td></td>
</tr>
<tr>
<td>SERV_SUPP X ACTIVITY</td>
<td>0.114*</td>
<td></td>
</tr>
<tr>
<td><strong>F-value</strong></td>
<td>1.3</td>
<td>16.68***</td>
</tr>
<tr>
<td><strong>$R^2$</strong></td>
<td>0.06</td>
<td>0.61</td>
</tr>
<tr>
<td><strong>Adj. $R^2$</strong></td>
<td>0.01</td>
<td>0.57</td>
</tr>
<tr>
<td><strong>Change in $R^2$</strong></td>
<td>0.55***</td>
<td>0.03*</td>
</tr>
</tbody>
</table>

$N = 104$. *Unstandardized regression coefficients are reported. * p < 0.1.; **p < 0.05; ***p < 0.01

As one can observe in Table 4, the hypotheses H1 and H2 are completely supported in Model 2 for both dependent variables, while hypotheses H3 is only partially supported (significance only for H3a). Thus, the three dimensions of the business system have a significant and direct
positive impact on service-oriented PSS benefits, but only significant positive effects of the OFFERING and RESOURCE constructs are confirmed for a product-oriented PSS benefits.

When we added the moderating effect of service suppliers support [SERV_SUPP] (Model 3), our results in Table 4 show significant interaction effects in two of the business system dimensions for both dependent variables: OFFERING and ACTIVITY. These results support our hypotheses H4b and H6a. However, for the other two complementary hypotheses (H4a and H6b) the direction of the effect is contrary to those expected.

In Figure 2, we present the slopes for each significant interaction with low, moderate and high intensity of service suppliers’ support. Analyzing Figures 2a and 2b, it is possible to observe that for product-oriented PSS benefits the more intensive the support of service suppliers is, the higher are the obtained benefits regarding the increase in the service offering dimension. The contrary happens when the company looks for service-oriented PSS benefits. In addition, we observed an opposite result when analyzing the activity system dimension (Figures 2c and 2d). In this case, we found for product-oriented PSS benefits: the more support from service suppliers, the less obtained benefits. However, more support from service suppliers is indicated to create more service-oriented benefit from the activity system dimension. Finally, we did not find statistical significance for the moderation effect of service suppliers in RESOURCE, as we proposed in both hypotheses H5a and H5b.
5 Discussion

First, regarding our control variables, the only statistically significant result was the one for the variable representing countries in the product-oriented PSS benefits model. This result indicates that the perception of these benefits in an emerging country like Brazil is higher than in a developed country like Italy. It reinforce previous studies, such as Paslauski et al. (2017), which found that emerging countries mainly use services to leverage their products sells. The
non-significative results for the other control variables can be explained with a lack of identification power in our sample based on the classification criteria used, since the literature provides strong argumentation for the relevance of these variables.

Regarding the main variables, our results confirmed our hypotheses that the service offering and resource base dimensions are important to obtain the benefits derived from both PSS orientations. However, the direct effect of the activity system dimension on product-oriented PSS benefits was not significant, even though it did show a significant positive direct effect on service-oriented PSS benefits. A possible explanation for this non-significance is that, since the activity dimension refers to the processes of developing and delivering a PSS solution, product companies looking for product-oriented benefits tend to be more dependent on their suppliers for these activities. This possible explanation is supported by the significant association of the moderating effect of service suppliers with this dimension. Another possibility is a lack of identification power in the sample, since even the moderating effect with this variable presented low significance (p<0.1).

Regarding the moderation effects, our findings show that for a product-oriented PSS the increase of support from service suppliers, with their external resources, results in more benefits due to the service offering dimension, as hypothesized in this paper. This finding implies that the product company keeps its internal resources focused on the main product-offering strategy and the service suppliers add a complementary service vision to the business (Karatzas et al. 2016; Raddats et al. 2017). This is usually a more comfortable situation for product companies that are at the beginning of the servitization journey (Karatzas et al. 2016; Visnjic & Van Looy 2013). In contrast, in a service-oriented PSS the moderation role is negative. Our explanation for this unexpected result relates to the concept of the service-oriented PSS, which promotes that the service should become the center of the PSS offering.
Our findings suggest that strategic decisions regarding service-centered offerings should rely on the product company and not on the supplier, as also Kowalkowski et al. (2011) argue. When suppliers are involved at this strategic level, the effect of the offering can be reduced in terms of the expected benefit, because the company tends to delegate one central aspect of the business. This means that, contrary to the product-oriented focus, service is not a complementary offering but the central one, therefore product companies should be concerned with internalizing this dimension.

Furthermore, the moderation of service suppliers regarding the activity business dimension also shows opposing effects for the two PSS orientations. First, contrary to our proposed hypothesis, our findings show a negative moderating effect of the suppliers for product-oriented PSS benefits. To understand this result it is necessary to analyze the illustration of slopes for the moderating role of service suppliers (Figure 2). In this figure, it is possible to observe that the contribution of the activity dimension is still positive for the dependent variable, despite the existence of the negative moderating effect. It is worth noting that this dimension mainly considers the integration of internal processes of product and services areas as well as the customer involvement in the solution development (Baines & Shi 2015; Kindström & Kowalkowski 2009). Looking at the outsourcing literature on servitization (e.g. Li and Choi, 2009; Wuyts et al., 2015), we can conclude that product companies that pursue a product-oriented PSS benefits will try to leave most of the operational activities to the service suppliers, resulting in a less relevant internal integration between product and services processes and areas. In contrast, the moderation role of service suppliers is positive for service-oriented PSS benefits in this dimension because the product company has the interest of internalizing service processes. In such cases, the service supplier can play the role of a mentor who helps the company to standardize and organize internal services and customer-related processes, i.e.
helping to develop the internal resources of the product company (Bastl et al. 2012; Finne & Holmström 2013; Ayala et al. 2017).

The different behaviors for product and service-oriented PSS with service suppliers’ support for the product company are graphically represented in Figure 3. In this figure we align our findings to the service triad perspective (Wynstra et al. 2015) by showing the expected force of the ties in the observed relationships according to the PSS orientation. In the first scenario (Figure 3a), the product company delegates the services to a service supplier because its main focus is still the product (Wuyts et al. 2015; Li & Choi 2009). Therefore, the strongest service tie is between the customer and the service supplier who is in charge of the delivery of the service part. The supplier has also a strong tie with the product company because the first helps the latter to establish the offering strategy, as shown in our results. In the second scenario the product company proceeds in the servitization transformation process (Visnjic et al. 2016) by developing a more radical solution where the product is no longer the main focus. In such cases the service supplier takes a supporting role during the development of the product company’s internal service activities, as shown in our findings. In this scenario the strongest ties should be between the product company and the service supplier because of the need for joint development, as well as between the product company and the customer because the product company delivers the PSS solution to the customer. Particularly, these findings complement the service outsourcing triad’s behavior as Li and Choi (2009) formulated it, in which the product company first acts as a ‘bridge’ between supplier and customer and then this initial position decays as the supplier becomes more directly involved with the customer. While this situation normally occurs in a product-oriented PSS, our findings show that the product companies that pursue a service-oriented PSS should not accept a secondary position in the service triad if they want to reach a more advanced servitization level and its benefits.
Finally, for the resource base system we could not find evidence of a significant moderation effect of the suppliers’ support for this dimension. This is a surprising result for us, since the servitization literature highlights that one of the main reasons to work with service suppliers is to acquire new knowledge and competences for the product company (Kowalkowski et al. 2011; Paiola et al. 2013). One reason for such a counterintuitive result can simply be the lack of discrimination concerning such an effect in our sample. Another possible explanation can be that most of the companies which are represented in our sample do not see the service suppliers as partners for developing internal resources, but as operational partners to decide the way the PSS will be offered (offering) and for the development of the service process that will be executed (activity).

6 Conclusion

In this paper we evaluate the contribution of service suppliers to the servitization process of product companies. This is one of the few quantitative studies that provides evidence for the question how service suppliers affect different servitization business dimensions and the obtained benefits for both product and service orientations. Therefore, our study helps to consolidate some prior suggestions of qualitative studies and offers new insights for scholars and practitioners.
Contributions to theory and future research
The research contribution of this study is twofold. The first contribution is related to the emergent service triad research field. We suggest that the behavior of the dyad company-supplier within a service triad in the context of servitization varies according to the orientation of the PSS strategy which the product company follows. This first finding complements prior research from supply chain management and operational management fields that focused only on product-oriented PSS. A second contribution is our response to the call from servitization literature requesting research which analyzes the link between product companies and suppliers for the delivery of PSS (Baines et al. 2017) from a relational point of view (Eloranta & Turunen 2015). By addressing this call, we contribute to the literature with a more fine-grained understanding of the impact of the support of service suppliers in the servitization process. This additional contribution allows a better understanding of how to work with these partners according to the strategic objectives of the product company.

Our study is limited to the analysis of the ‘content’ of a chosen strategy, which represents what should change in a company during the servitization journey. Future research should complement this study by analyzing the process and context of the organizational change that occurs related to introducing the supplier as a potential partner when implementing servitization. Furthermore, it is stated in the literature that product companies can receive support from service suppliers in different types of configurations during PSS development and delivery. However, we do not differentiate the specific effects of each of these configuration types. Additionally, regarding the sample differentiation between Brazil and Italy, the results show higher product-oriented PSS benefits for Brazilian companies, but we have not focused on this aspect. Paslauski et al. (2017) suggest that service infusion and product extension are greater in an emerging economy due to the companies’ lack of control over product development activities (which mainly occur in developed countries) and due to its
proximity with customers. Thus, future studies should investigate context-dependent strategies more in-depth.

**Contributions for practitioners**

Our research contributes to the understanding of the benefits which practitioners can obtain from servitization when this strategy is using the support of service suppliers. We demonstrate that managers of product companies should be aware of the importance of selecting suppliers and assigning roles that clearly align with their strategic objectives related to whether the product company’s servitization process aims to obtain product- or service-oriented PSS benefits. Managers who want to keep the product as a central activity of the company can use suppliers in supportive roles and involve them in decisions about solution offering strategies. They can also eventually delegate the service execution completely to their partnering suppliers. However, managers who want to pursue a more radical servitization process by focusing on service-oriented PSS benefits should be concerned with establishing the company’s own offering strategy while using the service suppliers as support for the internal development of the corporate service operation. In this case, managers should not use service suppliers for the complete delegation of activities, but instead with the aim of building knowledge with the help of the suppliers.

**References**


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Appendix A – Literature review for “service supplier in servitization”

**Systematic Review Procedure:** Search in Web of Science, Science Direct, Emerald, Taylor & Francis; Topics: Servitization & Supplier/Supply; Not temporal conditions; only peer-reviewed papers. Initial sample: 189 papers. After removing duplicates and initial review: 37 papers. After complete reading 11 papers were eliminated. Notes: ** Theory not explicit in the text.

<table>
<thead>
<tr>
<th>Year</th>
<th>Author</th>
<th>Journal</th>
<th>Study focus</th>
<th>Level of analysis</th>
<th>Theoretical perspective</th>
<th>Research Nature</th>
<th>Method procedure</th>
<th>Proposal</th>
<th>Contributions</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>(Windahl &amp; Lakemond 2006)</td>
<td>Industrial Marketing Management</td>
<td>Benefits and negative effects of the network for integrated solutions</td>
<td>Network perspective</td>
<td>Network theory**</td>
<td>Qualitative</td>
<td>Case study</td>
<td>Identifications of positive and negative characteristics and conditions in the network</td>
<td>A framework relating ties with important external relationships and internal activities’ impact.</td>
</tr>
<tr>
<td>2007</td>
<td>(Davies et al. 2007)</td>
<td>Industrial Marketing Management</td>
<td>Analysis of two types of organizations: system seller and system integrator</td>
<td>Network perspective</td>
<td>Business model**</td>
<td>Qualitative</td>
<td>Multiple-case studies</td>
<td>Forms of arrangement for integrated solution offering</td>
<td>The importance of hybrid organizational structures: emerging organizational forms</td>
</tr>
<tr>
<td>2008</td>
<td>(Johnson &amp; Mena 2008)</td>
<td>I.J.of Production Economics</td>
<td>Supply chain practices for servitization</td>
<td>Supply network</td>
<td>Supply chain practices</td>
<td>Qualitative</td>
<td>Multiple-industry case study</td>
<td>Use of a supply chain management model to study practices in servitization</td>
<td>Servitized supply chains need to be more responsive, relying on real-time information</td>
</tr>
<tr>
<td>2008</td>
<td>(Nordin 2008)</td>
<td>I.J.of Production Economics</td>
<td>Strategic sourcing decision and implications for competitiveness</td>
<td>Buyer-supplier</td>
<td>Strategic Positioning, Resource-based view, Transaction Cost Economics, Relational View</td>
<td>Qualitative</td>
<td>Multiple-case studies</td>
<td>Analysis of the four different competitive theories to understand how influence factors affect sourcing decisions and competitive advantage</td>
<td>Context as an important condition to define sourcing conditions resulting in competitive advantage</td>
</tr>
<tr>
<td>2011</td>
<td>(Kowalkowski et al. 2011)</td>
<td>Managing Service Quality</td>
<td>Organizational arrangements for service provision</td>
<td>Firm-organization</td>
<td>Organizational design**</td>
<td>Qualitative</td>
<td>Multiple-case studies</td>
<td>Study of firm-, offering-, and market-specific factors influence the way firm organize service provision with suppliers</td>
<td>Few firms organize for service provision solely. Organizational arrangements depend on contingency factors.</td>
</tr>
<tr>
<td>2011</td>
<td>(Lockett et al. 2011)</td>
<td>J. of Manufacturing Technology Manag.</td>
<td>Contributions of upstream suppliers</td>
<td>Buyer-supplier</td>
<td>Network theory**</td>
<td>Qualitative</td>
<td>Case study</td>
<td>An investigation of suppliers behavior depending on their role in PSS</td>
<td>Supplier can have a positive or negative effect on PSS</td>
</tr>
<tr>
<td>Year</td>
<td>Author</td>
<td>Journal</td>
<td>Study focus</td>
<td>Level of analysis</td>
<td>Theoretical perspective</td>
<td>Research Nature</td>
<td>Method procedure</td>
<td>Proposal</td>
<td>Contributions</td>
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<tr>
<td>2012</td>
<td>(Bastl et al. 2012)</td>
<td>I.J. of Operations and Production Management</td>
<td>Implications for suppliers when the buyer adopts servitization</td>
<td>Buyer-supplier</td>
<td>Transaction Cost Economics, Social Exchange Theory, Resource Dependence Theory, Relational Contracting</td>
<td>Qualitative</td>
<td>Case study</td>
<td>The use of Cannon and Perreault's relationship connectors to study the implications of the relationship</td>
<td>Characterization of buyer-supplier behaviors after implementing servitization</td>
</tr>
<tr>
<td>2012</td>
<td>(Hakanen &amp; Jaakkola 2012)</td>
<td>Journal of Service Management</td>
<td>Value co-creation in business networks with suppliers</td>
<td>Network perspective</td>
<td>Network value creation</td>
<td>Qualitative</td>
<td>Multiple-case studies</td>
<td>Identification of critical factors affecting the effective co-creation of solutions with suppliers</td>
<td>Elements affecting the co-creation of solutions</td>
</tr>
<tr>
<td>2012</td>
<td>(He &amp; Lai 2012)</td>
<td>I.J. of Production Economics</td>
<td>The impact of strategic and operational integration of supply chain on servitization</td>
<td>Buyer-supplier</td>
<td>Relational View**</td>
<td>Quantitative</td>
<td>Survey (n=229)</td>
<td>A conceptual model of supplier integration impact on servitization validated by a quantitative survey</td>
<td>Operational integration of supply chain has a positive direct effect on product-based services, while strategic integration has a positive direct effect on customer action-based service. When service is seen as an 'evil', outsourcing decisions are taken. When service is a strategic matter, supplier integration becomes relevant. Comparison between traditional product supply chain and demand-supply service chain</td>
</tr>
<tr>
<td>2012</td>
<td>(Saccani 2012)</td>
<td>I.J. of Industrial and Systems Engineering</td>
<td>Sourcing decisions for PSS</td>
<td>Buyer-supplier</td>
<td>Transactional approach*</td>
<td>Qualitative</td>
<td>Multiple-case studies</td>
<td>Investigation of servitization strategies and situations of outsourcing or insourcing</td>
<td></td>
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<tr>
<td>2013</td>
<td>(Bustinza et al. 2013)</td>
<td>Supply Chain Management</td>
<td>Customer effects on the supply characteristics</td>
<td>Supply network</td>
<td>Supply chain value creation</td>
<td>Quantitative</td>
<td>Survey (n=4,227)</td>
<td>Understanding of how firms manage servitization by suppliers’ integration</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>(Durugbo &amp; Riedel 2013)</td>
<td>I.J. of Production Research</td>
<td>The readiness of collaborative networked organizations for PSS</td>
<td>Network perspective</td>
<td>Delivery network</td>
<td>Qualitative</td>
<td>Multiple-case studies</td>
<td>A conceptual model for assessing the readiness of collaborative networked organizations for PSS</td>
<td>An assessment model for application in firms</td>
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<tr>
<td>2013</td>
<td>(Finne &amp; Holmström 2013)</td>
<td>Supply Chain Management</td>
<td>Triadic collaboration for service delivery</td>
<td>Service triads</td>
<td>Relational View**</td>
<td>Qualitative</td>
<td>Case study</td>
<td>Analyze service triads configurations</td>
<td>Proposal of collaboration configurations for service triads</td>
</tr>
<tr>
<td>Year</td>
<td>Author</td>
<td>Journal</td>
<td>Study focus</td>
<td>Level of analysis</td>
<td>Theoretical perspective</td>
<td>Research Nature</td>
<td>Method procedure</td>
<td>Proposal</td>
<td>Contributions</td>
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<tr>
<td>2013</td>
<td>(Paiola et al. 2013)</td>
<td>European Management Journal</td>
<td>Make or buy decisions for capabilities aiming at integrated solutions</td>
<td>Buyer-supplier</td>
<td>Capability development</td>
<td>Qualitative</td>
<td>Multiple-case studies</td>
<td>A framework for the internal and external development of capabilities. Inclusion of the network configuration in the development of what they called as Penrose-services in manufacturing firm.</td>
<td>When a company should externalize or internalize capabilities’ development for servitization. The use and contribution of the service factory concept and Penrose's firm's resources for the delivery of services within a network.</td>
</tr>
<tr>
<td>2013</td>
<td>(Spring &amp; Araujo 2013)</td>
<td>Industrial Marketing Management</td>
<td>Use of manufacturing own and other firm’s resources to provide product-related services</td>
<td>Network perspective</td>
<td>Extended RBV</td>
<td>Qualitative</td>
<td>Case study</td>
<td>The use of Cannon and Perreault's relationship connectors to study suppliers in different service types</td>
<td>There is no one best way to shape buyer–supplier relationships. The shape depends of the service type.</td>
</tr>
<tr>
<td>2014</td>
<td>(Saccani et al. 2014)</td>
<td>I.J.of Production Economics</td>
<td>Relationship between type of service offered and type of relationships established with suppliers</td>
<td>Buyer-supplier</td>
<td>Transaction cost economics, Social Exchange theory, Resource Dependence Theory, Relational Contracting</td>
<td>Qualitative</td>
<td>Multiple-case studies</td>
<td>Study of power structures in the network relationship</td>
<td>Power structures for integrators based on the positioning in their relationship with suppliers and customers.</td>
</tr>
<tr>
<td>2015</td>
<td>(Finne et al. 2015)</td>
<td>J.of Purchasing &amp; Supply Management</td>
<td>Inter-organizational power in complex networks involving solution integrators</td>
<td>Network perspective</td>
<td>Network positioning</td>
<td>Qualitative</td>
<td>Multiple-case studies</td>
<td>Identification of main tensions in the supply chain</td>
<td>Types and sources of tensions and ways to mitigate or manage them.</td>
</tr>
<tr>
<td>2016</td>
<td>(Burton et al. 2016)</td>
<td>Research-Technology Management</td>
<td>Tensions in the servitized supply chain</td>
<td>Supply network</td>
<td>Business model</td>
<td>Qualitative</td>
<td>Semi-structured interviews with key actors</td>
<td>Development of a structured method to organize and optimize the business processes of a servitized supply chain</td>
<td>Helping companies to identify the key business processes for supply chain operation.</td>
</tr>
<tr>
<td>2016</td>
<td>(He et al. 2016)</td>
<td>Production Planning &amp; Control</td>
<td>Business process organization and resulting value in servitized supply chain</td>
<td>Supply network</td>
<td>Value creation</td>
<td>Method</td>
<td>Theoretical proposition and case application</td>
<td>To study knowledge sharing dynamics in 3 types of collaboration and 2 types of servitization business model innovation</td>
<td>Knowledge sharing has different intensities, depending on collaboration and business orientation.</td>
</tr>
<tr>
<td>2017</td>
<td>(Ayala et al. 2017)</td>
<td>I.J.of Production Economics</td>
<td>Knowledge sharing dynamics in the buyer-supplier relationship in relation to servitization</td>
<td>Buyer-supplier</td>
<td>Knowledge transfer, Business model</td>
<td>Qualitative</td>
<td>Multiple-case studies</td>
<td></td>
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<tr>
<td>Year</td>
<td>Author</td>
<td>Journal</td>
<td>Study focus</td>
<td>Level of analysis</td>
<td>Theoretical perspective</td>
<td>Research Nature</td>
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<td>Proposal</td>
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<tr>
<td>2017</td>
<td>(Bigdeli, Baines, et al. 2017)</td>
<td>I.J. of Production Research</td>
<td>Risk perception and servitization implications in network positioning</td>
<td>Network perspective</td>
<td>Network positioning</td>
<td>Qualitative</td>
<td>Multiple-case studies</td>
<td>Studying risk perception and implications when considering supply chain positioning for servitization</td>
<td>Partnerships within supply chain networks can mitigate risk and are proven to be crucial for building entry barriers in servitization.</td>
</tr>
<tr>
<td>2017</td>
<td>(Raddats et al. 2017)</td>
<td>I.J. of Operations and Production Management</td>
<td>The contribution of a dyadic perspective to identify capabilities required for servitization.</td>
<td>Buyer-supplier</td>
<td>Resource Based View / Dynamic Capabilities</td>
<td>Qualitative</td>
<td>Multiple-case studies</td>
<td>Identification of capabilities in the dyadic between buyer-supplier and between manufacturer and customer</td>
<td>Capabilities are developed interactively in the dyadic relation.</td>
</tr>
<tr>
<td>2017</td>
<td>(Story et al. 2017)</td>
<td>Industrial Marketing Management Journal of Business &amp; Industrial Marketing</td>
<td>Identification of complementary and competing capabilities</td>
<td>Network perspective</td>
<td>Multi-actor perspective / Capabilities</td>
<td>Qualitative</td>
<td>Qualitative interviews</td>
<td>Six-key business activities for advances services capabilities</td>
<td>Framework for defining capabilities related to different business activities.</td>
</tr>
<tr>
<td>2017</td>
<td>(Vural 2017)</td>
<td>Journal of Business &amp; Industrial Marketing</td>
<td>Supply chain management in service-dominant logic</td>
<td>Literature</td>
<td>Not applicable</td>
<td>Systematic review of the literature</td>
<td>Literature review</td>
<td>Descriptive and thematic analyses to understand the field</td>
<td>Future research opportunities</td>
</tr>
<tr>
<td>2018</td>
<td>(Chakkol et al. 2018)</td>
<td>I.J. of Operations and Production Management</td>
<td>Functions, roles and practices of boundary spanners that connect with suppliers</td>
<td>Buyer-supplier</td>
<td>Boundary theory</td>
<td>Qualitative</td>
<td>Case study</td>
<td>Study of the boundary spanning between service suppliers and manufacturers.</td>
<td>Identification of the boundary spanning roles and practices that form functions for solutions provision.</td>
</tr>
</tbody>
</table>
Appendix B – Questionnaire

Questionnaire items to assess Service Offering [OFFERING]: Concordance Likert scale: 1-strongly disagree to 5-strongly agree.

a) The service offering in my company is considered a strategical aspect for our competitiveness.

b) We compete primarily in services differentiation.

c) Our services are offered spontaneously when a customer need is identified.

d) We understand well how our customer perceives the value of our services.

e) We are more customer-oriented than our competitors.

Questionnaire items to assess Resource Base [RESOURCE]: Concordance Likert scale: 1-strongly disagree to 5-strongly agree.

a) To develop our services, we frequently develop new competences inside our company.

b) The human capital (individual expertise) of my company is a source of competitive advantage.

c) The internal knowledge owned by my company is considered a source of competitive advantage.

d) Our company is very flexible to market changes, being able to adapt quickly.

Questionnaire items to assess Activity System [ACTIVITY]: Concordance Likert scale: 1-strongly disagree to 5-strongly agree.

a) Our services and products are developed together and simultaneously.

b) The service area has an active role in taking strategic decisions about new products and markets.

c) Our different functional areas often work together in the development of new products and solutions.

d) Our customers have an active participation in the development of our new products and services.

e) Other business units of our company are very active in new product and service development.

Questionnaire items to assess Product-oriented benefits [P-O_BENEF]: Concordance Likert scale: 1-strongly disagree to 5-strongly agree.

a) Our service solutions facilitate the sales of new products to our current customers.

b) Our services solutions facilitate the development of new products for the market.

c) Our services solutions allow us to reach new customers with the extant products of our portfolio.

d) Our services solutions allow us to reach new markets with the extant products of our portfolio.

Questionnaire items to assess Service-oriented benefits [S-O_BENEF]: Concordance Likert scale: 1-strongly disagree to 5-strongly agree.

a) Our service solutions help us to retain customers and to increase their loyalty.

b) Our service solutions help us to adapt our products to customers’ needs.

c) Our service solutions are often seen as innovative by our customers.

d) Our services solutions represent a significant value added to our customers.

Questionnaire items to assess support from Service Suppliers [SERV_SUPP]: Concordance Likert scale: 1-strongly disagree to 5-strongly agree. Formative scale (composite).

a) The main services offered to our customers are developed and executed predominantly by our own company.

b) The services offered to our customers are developed and executed predominantly by outsourced companies.

c) The services offered to our customers are designed in our company, but their execution is outsourced.

d) To develop our services, we require complementary competences from outside (other partner companies).

e) Suppliers are active partners in the development of new solutions for our products and services.

Questionnaire items for control variables:

a) Please, inform the size of your company in number of employees.

b) Please, describe your main business focus: (B2B; B2C; other).

c) Please, describe how your company’s portfolio is composed (in percentage): (products/services).