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# **Customer-pulled and provider-pushed pathways for product-service system: The contingent effect of the business ecosystems**

## **Abstract**

**Purpose:** The overarching aim of this paper is to investigate distinctive pathways for product-service system development. Moreover, it investigates the contingent effect of the business ecosystem in terms of being provider-pushed or customer-pulled.

**Design/methodology/approach:** The study adopted a case-based research, performed in the Brazilian and Danish healthcare industries in order to explore the subject.

**Findings:** The results reveal that the capital available for investments influence the pathway. The customer-pulled product-service system fast evolved to become result-oriented and connected to a complex resource-dependent network in the business ecosystem. The provider-pushed product-service system showed a slow evolutionary pathway, limited to product-oriented offerings with low dependence among actors in the business ecosystem.

**Originality/value:** The research offers various managerial implications for PSS providers, policymakers and customers of the healthcare industry.

**Keywords:** Product-service system (PSS); Servitization; Business Ecosystem (BE); Healthcare Industry.

**Paper type:** Case study.

## **1. Introduction**

Servitization, where manufacturing companies add services to their product offerings, is becoming increasingly important to manufacturing companies worldwide (Vandermerwe and Rada 1988, Kreye et al. 2013). Servitization can be observed across industry sectors, as evidenced by companies such as: Grundfos which offers through-life support for their water-pump systems, Vestas which provides in-service support for their wind turbines and farms, and BAE Systems which offers a range of operational support services for its manufactured defence equipment. Offerings in servitization evolve around the physical product which is combined with a range of services to

become product-service system (PSS) (Nemoto et al. 2015). PSS are defined as an inseparable integration of products and services (Baines et al. 2007) and require a different operations strategy to traditional manufacturing (Alghisi and Saccani 2015, Kreye et al. 2018). Servitization is “*advantageous in some circumstances, but not so in others*” (Schmenner 2009, p. 431) which points to the importance of the business context (“circumstances”). In addition, the country in terms of the economic structure in which the manufacturing firm is located seems to make a difference. The USA, for example, showed a higher level of servitized manufacturing firms (58.57%) than China (0.97% ) in 2007 (Neely et al. 2011). It can be observed that there are potentially strong differences between developed economies, such as the USA or Europe, and emerging markets, such as China and Brazil.

The delivery of PSS is often actuated through a service system necessary to fulfill the requirements (Raddats et al. 2017). The composition of the service system in terms of number and links between companies in the value network can differ widely. For example, much of the servitization literature has focused on a single PSS provider and the capabilities they need to successfully provide the PSS (Baines et al. 2009, Kreye et al. 2014). Tan et al. (2006) pointed out that PSS requires a dependency between the provider’s strategies (provider perspective) and customer’s environment (customer needs), however they focus on the impact of this dependency to the provider’s product development activities. Other researchers have highlighted the need for a complex supply network of companies to gather the capabilities of providing PSS (Löfberg et al. 2015). The composition of the service system can be affected by the PSS development trajectory (Kodama 2014), that is, whether the PSS development is driven by the provider or by the customer. One challenge is to go towards “*a relational rather than dyadic perspective between supplier and customer*” (Gaiardelli et al. 2015, p. 1167).

The majority of current literature has focused on the provider-pushed development of PSS offerings where the provider adopts a servitization strategy to improve its competitiveness (Wise and Baumgartner 1999). Less attention has been given to trajectories where the customer pulls PSS development in order to benefit from increased value (Davies et al. 2007), such as the outsourcing of non-core activities (Wise and Baumgartner 1999) and the reduction of operational risk (Reim et al. 2016). In addition, little attention has been paid to the possible effects of the business ecosystem in determining PSS development.

Existing servitization research has not investigated the composition of a service system as a result of the PSS development trajectory or of the business ecosystem. More specifically, the following two issues remain under-researched and are empirically addressed in this paper. First, there is a lack of in-depth investigation into the effects that the business ecosystem has on PSS development. Current research suggests that the business context shapes PSS development, as changes in the supply chain position (Finne and Holmström 2013) and availability of funds (Kreye et al. 2014) can favour provider-pushed or customer-pulled PSS development. However, the subcontracting relationships familiar in traditional supply chains are likely to find it *“difficult to reliably deliver a complex solution bundle involving multiple technologies, capabilities, and services”* (Williamson and DeMeyer 2012) and which *“requires the management of complicated interactions and an exchange of knowledge between many, mutually dependent partners—a task to which ecosystem strategies are better attuned”*. Yet, there is a gap in the research on the specific links between business ecosystems and PSS development. Second, no insights exist on the effect of provider-pushed or customer-pulled PSS on the ability of one or multiple companies to provide PSS. Emerging research applies a systems perspective to servitization (Davies et al. 2007, Badinelli et

al. 2012) with findings regarding the importance of the composition of the service system. However, it remains unclear how service systems are created and specifically how PSS development determines the service system composition. Corroborating with this idea Finne, Brax and Holmström (2013) point out that, although literature focuses on forward unidirectional servitization, there are two other possibilities: “*Companies can move also in a reversed direction, move possibly back and forth, or extend their position along the servitization continuum*” (Finne et al. 2013, p. 2).

This paper aims at answering the following research questions (RQs): RQ1: How do the customer and provider drivers for PSS affect the composition, offerings and roles of the PSS? RQ2: How does the business ecosystem affect the PSS development pathway in terms of favouring a provider-pushed or customer-pulled PSS development? We investigate these RQs through an inductive and exploratory research design, presenting two case studies in the healthcare industry carried out in Brazil and in North Europe. Findings from the research suggest that the dynamic of distinctive business ecosystems encourage the development of different PSS trajectories, namely pushed by the provider or pulled by the customer. Specifically, the level of investments available for the customer affect PSS development. Low levels of investments are likely to cause customer-pulled PSS development, characterized by a fast evolutionary pathway towards a result-oriented PSS, linked with a complex service system and business ecosystem. In contrast, the availability of high levels of investments support a provider-pushed PSS development, with a slow evolutionary pathway limited to product-related services, which results in the formation of a service system provided by one PSS provided.

This paper comprises six sections. Section 2 offers an overview of the current literature. Section 3 describes the methodological approach of this research, while

Section 4 and 5 present and discuss the findings. Lastly, Section 6 outlines the conclusions of this study.

## **2. Literature review**

### ***2.1 Servitization and PSS***

For the purpose of this research, we define services as activities or processes where the service provider, customer and the service issue are combined in a triangular relationship (Gadrey 2000). Servitisation offers potential benefits for manufacturing companies such as (i) increased customer demand with lock-in situations, (ii) further growth, increased profits and stability, and (iii) rationalized scarce resources (Wise and Baumgartner 1999). Servitization covers a broad range of offerings (Tukker 2004, Smith et al. 2012) and thus requires various kinds of PSS to deliver the different value propositions to customers (Tukker, 2004).

PSS can range from product-focused offerings to performance-based arrangements. For product-oriented PSS, the services evolve around the product and include maintenance or after-sales services such as repair and exchange of spare parts (Legnani et al. 2009). For use-oriented PSS, the product is typically not owned by the customer but is leased or shared (Baines et al. 2009). In performance-based PSS – or results-oriented PSS (Tukker, 2004) – the provider assumes responsibility for the equipment's operation, including the necessary processes to operate and maintain it (Settanni et al. 2016). Many companies offer the full range of these PSS, such as Grundfos, which operates in the water-pump industry and offers PSS ranging from pair and exchange to improved reliability and performance of its equipment. Other companies specialize in their PSS offerings. For example, LafargeHolcim (2018), a manufacturer of cement production plants and equipment, offers performance-based

services, including the set-up and operation of mobile cement plants close to customers' building sites. Thus, different kinds of PSS exist and the industrial uptake of these varies across companies and Industry sectors.

PSS offerings differ in their level of operational complexity, depending on the number of resources needed to achieve the intended outcome and the number of components and their interrelationships in the service system (Kreye 2018). Maintenance or after-sales services require less complexity with regard to the operational processes and the delivery system than performance-based PSS. The level of PSS complexity has important implications for the providers' capabilities needed to deliver them and their ability to achieve the potential benefits of servitization (Benedettini et al. 2015, Reim et al. 2016). For example, providing continuous service support or 24-hour spare-part delivery requires a high amount of resources with regard to manpower, logistics, and physical components. Similarly, the service system of a performance-based PSS is more complex because it includes many different and linked components, such as logistics, HR management, production and services (Badinelli et al. 2012). Complexity can further arise from the dynamic nature of services, owing to the "openness" of services, i.e., the constant adaptation to customer requirements and the business context, such as industry standards (Badinelli et al. 2012).

The composition of a service system regarding company involvement and roles within the system can be influenced by the complexity of the PSS (Kreye et al. 2015) and by various other drivers. This research focuses particularly on the role of providers or customers in pushing or pulling PSS development in the market as a possible influence on the complexity of the provider network.

## ***2.2 Provider-push and customer-pull PSS development***

PSS development can be driven by the provider or the customer; for both parties a

servitization strategy offers successful business opportunities (Smith et al. 2014, Raddats et al. 2017). The drivers for the adoption of servitization have been categorized into economic, environmental and social advantages (Oliva and Kallenberg 2003), as summarized in Table 1.

**<Please insert Table 1 about here>**

These drivers depend on the PSS providers' or customers' perspectives and can have defensive or offensive strategy reasons. The drivers for PSS providers have received much attention in the servitization literature. For PSS providers, economic advantages arise from the creation of customized and knowledge-intensive solutions, which may improve both product and service sales (Antioco et al. 2008). Furthermore, PSS offer a consistent and predictable cash flow, aids replacing the fluctuating and uncertain income from product sales (Wise and Baumgartner 1999). Environmental advantages are related to the improved performance of the equipment through regular inspections. The responsibility for the equipment's operation, including the use of resources and maintenance, shifts to the PSS provider. The provider is able to use its in-depth technical knowledge to improve the products' performance and decrease environmental impact (Pereira and Carvalho 2011), and also provisions dematerialised services (Mont 2002). This can lead to extended life-cycles of the equipment and improve environmental sustainability. Social advantages may arise from a closer relationship between the PSS provider and the customer (Kreye et al. 2018); for example, increased information flow and communication (Alghisi and Sacconi 2015) enable customer lock-in situations and an improved competitive advantage for the provider (Wise and Baumgartner 1999).

Customer drivers have received less attention in the servitization literature and is generally poorly explored (Prieto and Carvalho 2011). For customers, economic

advantages can arise from the outsourcing of non-core activities, such as the maintenance of equipment leading to cost savings. Further, PSS can change the ownership structure and thus create various payment schemes offering flexibility and predictability in cash flows (Mont 2002). Social drivers increase the closeness of the provider relationship, which in turn provides the customer with customized information about the operation of the equipment, so that its needs can be better satisfied (Raddats et al. 2017). The relative dominance of the drivers in terms of the balance between advantages of a servitization strategy for providers in comparison to the advantages for customers creates situations of provider push or customer pull. A provider-pushed market is created when the PSS provider strategically follows the possible advantages of a servitization strategy through incorporating services into their offerings. Tan and McAloone (2006) describe PSS as an opportunity for the provider to improve innovativeness and customisation of their offering. A customer-pulled market is created when customer advantages prevail and they customers demand PSS of increasing complexity.

According to Oliva and Kallenberg (2003), evolving along the product-service offerings continuum is a deliberate and evolutionary strategy and follows four steps: Consolidating product-related services; entering the installed-base service market; expanding to relationship-based services or expanding to process-cent services; taking over the end-user's operations.

### ***2.3 PSS and business ecosystems***

To successfully provide PSS, the provider's wider business environment needs to be considered including strategic partnerships with customers (Raddats et al. 2017, Kreye et al. 2018), supplier networks (Löfberg et al. 2015), and wider regulatory developments (Takey and Carvalho 2016). This increased operational complexity can be

conceptualised using business ecosystems (Williamson and DeMeyer 2012). A business ecosystem (BE) is an “*intentional community of economic actors whose individual business activities share in some large measure the fate of the whole community*” (Moore 1993); thus, the health and performance of each actor depends on the whole ecosystem (Iansiti and Levien 2004).

In order to deliver complex product-service solutions to customers, the traditional supply chains relationships with a few well-defined activities are not enough (Manzini and Vezzoli 2003, Alghisi and Sacconi 2015). Rather, there needs to be a management of interactions among mutually resource-dependent partners exchanging knowledge, technologies, and capabilities (Williamson and DeMeyer 2012). Actors in a business ecosystem interact in complex ways, through simultaneous cooperation and competition (Kang and Wimmer 2009, Adner and Kapoor 2010). The ability to create value is dependent on each actor producing complementary products or services in the business ecosystem (Kapoor and Lee, 2013), and the actors’ abilities to “*co-evolve around a shared set of technologies, knowledge and competencies*” (Moore, 1993). In addition, the investments are synchronized to build value and increase efficiency (Williamson and De Meyer, 2012).

For mapping the business ecosystem, Takey and Carvalho (2016) suggest identifying “*the player, the roles (such as leading firm, regulators, and contributors) and understanding the interdependencies among them.*” Business ecosystem boundaries can be fuzzy and organizations can be understood as open systems in which resources are exchanged with others in the environment (Garnsey and Leong 2008). Business ecosystem can be situated within a complex industrial system that can spread the boundaries of industrial sectors and nations (Li 2009).

The business ecosystem includes distinctive actors as focal firms, upstream suppliers and downstream complements and regulators (Adner and Kapoor 2010). In addition to supply chain partners, BE links different organizations, such as: customers, employees, contract manufacturers (Li 2009), public institutes, government associations, universities, and other stakeholders (Rong et al. 2013).

Understanding the coordination of roles in business ecosystems is critical, where asymmetries can arise (Adner and Kapoor 2010). The business ecosystem evolution is characterized by expansion, leadership and self-renewal or death (Moore 1993). Thus, it is important that value increases in every part of the business ecosystem, and there is little slippage (Lepak et al. 2007).

Some actors in the business ecosystem can support or delay the adoption of a servitization strategy. As pointed out by Geels (2005), regulations and policies are some of the elements that can influence the transition from one system to another. In the PSS context, for example, Finne et al. (2013) describe how developments in technology maturity and changes in regulation influenced the supply chain intermediation and subsequently caused the PSS provider to “downgrade” their level of servitization. Thus, regulations (present and future) can form significant drivers that stimulate PSS development, specifically with regard to environmental performance. Other external factors arise from the customers’ political and economic environment which can impact the funds they have available and thus their ability to procure a system (Kreye et al. 2014). PSS provision requires regular input from the provider and the customer; the customer needs to be motivated to invest the necessary time and resources to maintain the relationship and manage information exchange (Kreye 2016). Furthermore, the existence of close partnerships for the development and implementation of PSS, such as

universities and collaborating firms, can form strong environmental influences and incentives (Muller and Zenker 2001).

Despite the increasing importance of BE to competitive success, there is still a gap in the literature on the contingent effects of it in PSS development.

#### ***2.4 Conceptual framework***

A business ecosystem theoretical lens was applied for understanding PSS pathways and answering the research questions (RQs). First, we investigated the drivers and the differences between provider-pushed and customer-pulled PSS pathways, concerning the composition, roles and offerings, grounded in the literature and summarized in Sections 2.1 and 2.2. Second, we explored the contingent effect of the business ecosystem configuration and dynamics in PSS development, grounded in the literature discussed in Section 2.3. Figure 1 illustrates the conceptual framework of this research.

**<Please insert Figure 1 about here>**

### **3. Research methods**

To investigate the RQs, we present evidence from two case studies. Qualitative case study research is the most suitable method for this type of research for the following two reasons. First, this research is inductive and exploratory in nature. There is a need for qualitative exploratory research to develop new insights and understanding and build theory (Siggelkow 2007). This is particularly relevant for this research focus owing to the limited empirical and theoretical insights into business ecosystems and servitization. We aim to build theory by providing structured empirical evidence and the case-study method is suitable for this purpose (Yin 2018). Second, this method allows us to study the impact of external conditions on internal reactions (Yin 2018). Servitization is context-specific (Alghisi and Sacconi 2015), focusing on the influence of the business

ecosystem on PSS development strategies. It further offers in-depth evidence to explore the research issue (Siggelkow 2007).

### ***3.1 Case selection***

The cases focus on the healthcare industry, which is an ideal setting for this investigation. The healthcare sector is characterized by high levels of sector regulations that define the business ecosystem and conditions. Impacts on PSS development can come from levels of regulation, available technology and pressure from competition (Vandermerwe and Rada 1988, Neely et al. 2011, Kreye et al. 2014). The healthcare sector has also been highlighted as a suitable focal sector for analysing business context (Kapoor and Lee 2013). Thus, focusing on one industry sector as the setting for our cases ensures a cross-case comparison of the findings and limitations of the impact of these factors. The healthcare sector creates a well-defined business context with strong economic pressures for companies to be open for innovation. This allowed us to study the impact of the business ecosystem on companies' servitization strategies. In addition, we focused on a business-to-business (B2B) context in healthcare, avoiding the patient perspective, because we aimed to investigate the dependencies among the B2B partners, customers or suppliers in the PSS business ecosystem. Given the newness of the research, this well-defined business context formed ideal conditions for the collection of data for our case studies.

The cases were selected based on their business ecosystem and PSS drivers for development, customer versus providers. Case A is located in Brazil, an emerging economy; while Case B is located in North Europe, a developed economy. The reasons for the selection was based on the reported findings in the literature that different developments can be observed in terms of servitized manufacturing firms and the expansion of servitization strategies in different types of economies (Neely 2008, Zhang

et al. 2016). Thus, these two cases allowed for a comparison of the business ecosystems and how these might influence processes and relationships within the PSS settings.

The cases focused on large manufacturing firms as PSS providers for three main reasons. First, larger manufacturing firms are more likely to be servitized (Neely et al. 2011, Raddats et al. 2017). Second, large providers are typical for the healthcare industry because of the level of technical complexity and financial investment (Kreye et al. 2015), while niche technologies may be provided by SME, the provision of PSS is typically undertaken by larger companies. Third, we required our cases to be comparable across national boundaries. We thus focused on equipment that was available both in the European and the Brazilian context instead of niche technologies that are not adopted globally.

### ***3.2 Data collection***

The data were collected from multiple sources of evidence, including interviews, notes from discussions with senior managers (General managers, Sector leaders etc) and documents from the organization to gather a rich picture of the investigated case study (Yin 2018). We collected 20 semi-structured interviews with PSS customers and providers in Brazil and North Europe. Business contexts can be represented in a firm's transaction environment. For servitization, the transaction environment includes both the customer and PSS provider (Raddats et al. 2017), in our case the hospital (customer) and the equipment provider (provider). For this reason, we focused our data collection on these actors. The main aspects of the current literature, particularly the drivers for moving to a servitization strategy and maintaining these operations – both internal and external – were investigated during interviews to obtain an in-depth and comprehensive picture of the cases. The interviewees were selected based on their experience and involvement in the PSS arrangement and interaction with the PSS partner. The

interviews lasted 60 to 90 minutes each and were guided by a set of questions focusing on the business environment, internal operations and relationship-specific issues between provider and customer. Table 2 depicts the interviewees for both cases. For confidentiality purposes, the companies are hereby named as Case A and Case B.

**<Please insert Table 2 about here>**

The interviews focused on characterizing the business and operation strategy, and the business ecosystem, particularly the relationship between the PSS provider and customer. A set of questions was prepared, based on the theoretical background presented in Section 2, and utilized in the interviews to facilitate discussions with the interviewees. The interviews were recorded and transcribed. The data collection stopped when conceptual saturation was achieved and no new insights were gathered through additional interviews. The study findings were presented back to the companies to obtain additional feedback and comments. This ensured the rigor of the findings and reduced the influence of subjectivity introduced by the case study method. In addition, we collected secondary data including contracts and organization documentation to triangulate our findings, mitigate method bias and improve internal and external validity and case-study rigor (Yin 2018).

### ***3.3 Data analysis***

The unit of analysis was the dyad between PSS provider and its customer. The interview transcripts and additional material were analyzed by adopting systematic combining to inform our data analysis (Miles et al. 2014). The collected data was analysed qualitatively through iterative coding into major thematic categories informed by the research question and comprehensive literature review (Miles et al. 2014). The categories emerged logically from the theoretical framing of the research in addition to

the empirical data analysis. The rich datasets were summarized and written up as case reports to be presented to the case company for verification. As part of our coding and analysis process, the authors traveled back and forth between analysis, collection and extant studies, hence facilitating theory building (Miles et al. 2014).

## **4. Findings**

The findings are presented for the two cases individually. The cross-case comparison is included in the discussion (Section 5).

### ***4.1 Case A – customer-pulled PSS***

#### **4.1.1 Business ecosystem**

The context of Case A was characterized by an increasing amount of regulations in the healthcare system that monitored, for example, the level of patient care and safety. These regulations led to the introduction of a formal tendering process and defined the interaction between PSS provider and customer. The Head of section (Case A) highlighted: *“This issue is a requirement of society, not a requirement of the provider.”* The regulations particularly influenced the PSS bidding process, which had become complex, longstanding, and demanded specific resources, as the Head of section (Case A) explained *“It is very laborious to prepare a bidding process. It requires expertise to build processes and almost oriental patience.”*

In addition, available funds were limited in Case A, for two reasons. First, Brazil charged high taxes on imported equipment resulting in very high purchase prices. Second, Brazil has a Single Health System (SUS from the anachronism in Portuguese), in which the use of the available funding was set by the government in terms of the percentage available for purchasing products or services. In the 1980s, funding was

mainly available to purchase equipment and a smaller portion allocated to services. This caused budgeting issues leading to the seasonality of available funds, as the Chief physicist (Case A) explained: *“The state budget has a limit. Until October, you have money, and then you run out of the state funding. (...) the last three months you will be swimming short.”* In the 1990s, funding could only be spent to lease the equipment, where the provider retained the equipment as property and offered maintenance for its upkeep. By the end of the mid-90s, the set percentage of funding to be spent for services increased further and equipment leasing was banned, leading to result-focused PSS. The Chief physicist (Case A) explained: *“It is a service solution. Once the company wins the competition, it installs the machines, provides the inputs and all the supporting systems to maintain laboratory system operating.”*

#### 4.1.2 Customer-pulled PSS development

As a result of the regulatory context, Customer A was not able to own the equipment anymore but purchased the result-oriented PSS, as administrator (Case A) pointed out: *“We don’t buy equipment or inputs or supporting systems, we buy medical test results.”* This led to a customer-pulled PSS development, which was characterized particularly by being result-orientated. Thus, most of the PSS roles were retained by the provider, while the hospital experts analyzed the test results. This, in turn, increased the drive towards acquiring the latest technological advancements. The Chief physicist (Case A) stated: *“As the provider is the equipment owner, it is responsible for equipment maintenance and technological advancements. It is also in its interest to improve system effectiveness.”* In addition, reducing environmental impact was is a challenge to laboratories and it also led to a complete PSS solution, including equipment end of life (EOL) and samples disposal responsibilities, as pointed out by Laboratory director (Case A): *“Depending on the solution agreed, the provider is also responsible for the*

*final disposal of residues produced in the process.”*

The evolution in the procurement regulation constraints demanded payment scheme flexibility, changing the equipment ownership structure. This extended to hospitals seeking to offer a complete portfolio for their patients, as the Head of section (Case A) explained: *“The concept in healthcare today is to offer a complete solution for the patient. (...) [We] want patients to be able to solve all their needs here.”* Due to high equipment costs, government regulations and funding cuts, the hospital in Case A pulled the development of performance-based PSS, giving them access to up-to-date equipment, as explained by the Chief physicist (Case A): *“It was the way to avoid scrapping labs.”* With the purchase of a PSS rather than equipment, the hospital can renew its equipment, because the PSS provider is interested in offering the latest machines to allow for technical improvement. Owing to payment per result, cost savings can be achieved by improving the efficiency of the equipment, so the PSS provider improves their profitability. This corroborate with Adaku et al. (2018) considering that in developing economies underdeveloped infrastructure is as serious challenge.

Funding seasonality and limitations in the funding use led to shortcomings in the hospital’s ability to perform patient care. This led to operational risks as the hospital faced situations in which, during some periods, the lab had the equipment but no inputs, and, during other periods, inputs were available but the machinery broke, and there was no money for maintenance. This was a particular challenge during the 1980s, when the PSS were product-focused. Since then, the customer had changed its procurement procedure from sourcing from multiple providers to single-sourcing. The Head of section (Case A) explained: *“It is very difficult to keep the system working properly when you have different providers with different levels of interests.”* In the

performance-based PSS arrangement, the customer sourced a complete solution, including equipment, infrastructure, consumables (disposable going to equipment), computer systems including paper and cartridges, calibrators, quality control and specialized technical assistance (engineers, biochemical and biomedical) from one PSS provider. *“The supplier offers us a service, delivering all these requirements, so we can perform a test and we pay for the package”* (Head of section, Case A). It was thus the PSS provider’s responsibility to seek partners with capabilities it was lacking and create a network with other suppliers. This network was practically invisible to the customer as the Laboratory director (Customer, Case A) explained:

*“The supplier charges us per medical test. In order to create a solution, it goes to the market. For example, if we need a computer or a water purification system, the supplier goes to the market and creates a network with other suppliers, such as computer providers or water purification system’s manufacturers in order to deliver a complete solution to the customer (us). We only see one single provider. If the laboratory system fails, we contact a single provider.”*

In Case A, it was the customer that suffered strong pressures from both the SUS and Government, facing the challenges of redesigning the supply chain in a whole PSS package, considering constraints in investment and ownership pattern, with a performance-based value proposition. The PSS provider played a key role in assembling and managing the PSS package but, in the initial steps, the customer used their bargaining power to pull the PSS. Figure 2 shows the scheme for the business ecosystem for customer-pulled PSS.

**<Please insert Figure 2 about here>**

## **4.2 Case B – provider-pushed PSS**

### 4.2.1 Business ecosystem

The context of Case B was also characterized by an increasing amount of regulation, which affected the tendering of contracts between the customer and the provider. This also increased the level of complexity of the interactions between the provider and the customer as the Sales manager (Case B) explained:

*“If you look back 25 years, I could go to a customer and sit down with him in his office. And when I was gone, we had settled the deal. (...) Nowadays, you have a bunch of people you need to address, from the strategic purchaser to the medical, technical advisor to the consultant. (...) and you need to be able to speak to everybody in order to position yourself the best way.”*

Furthermore, Case B was characterized by high investments into the healthcare system to develop new infrastructures, erect new hospitals and purchase new equipment. The General manager (Case B) highlighted: *“They are going to build 16 new hospitals in [Region A], an investment of €5.6 billion.”* As a result, the customers placed high importance on owning the equipment. This led to an increase in product sales in Case B over recent years as well as a benefit for the support service part of their organization, as the Business controller (Case B) clarified: *“There has been a huge growth in the in-store base over the last years and we in the service organization [can see the] profit. We have to support and provide services to our in-store base.”*

Owing to the availability of high investments in Case B, customers asked for the latest functionalities of the equipment and drove the use of new parts. *“It’s technology-driven”* (Business controller, Case B). *“They [customer hospital] are very new, (...) they are one of the most advanced centers in Europe”* (General manager, Case B). This pushed the level of innovation within the PSS provider, focusing particularly on technological advances, as highlighted by the Sales manager (Case B): *“This also pushes the research and development department to always come up with new products or new ideas, and create new possibilities.”* This led to one of the customer hospitals

becoming a world-wide leader in its field, as highlighted by Service engineer 3 (Case B): *“We were actually the first place in all the world to do (...) this system so they have also been included in the development of the units.”*

#### 4.2.2 Provider-pushed PSS development

As a result of the case context, the customer in Case B retained some service capability to enable it to do first-line services itself. It could thus give fast support when needed; for example, when the equipment broke down, as the Service manager (Case B) clarified: *“They think they can save money and have better availability of the equipment.”* Issues that cannot be solved by the in-house first-line service engineers were elevated to the PSS provider. Thus, the service business was a core part at the equipment purchase, as highlighted by the Service manager (Case B): *“There will always be a kind of service agreement attached.”*

The provider-pushed PSS development was characterized particularly by the product orientation. The PSS provider ensured its competitive advantage, particularly through the technological advancement of its equipment, as the General manager (Case B) highlighted: *“I think that they have got trust in our products. (...) it [the customer] is confident that it gets what it was looking for.”* The service business was organized around the equipment to ensure its operability and a high level of technological advancement. Thus, the PSS provider used their service business to increase their product and parts sales, as the Service manager (Case B) explained: *“If it wants some new applications, it maybe wants the new software, (...) this perhaps also includes new hardware. (...) So, it is not only maintenance. It is also about having the equipment (...) at the state-of-the-art performance.”* To achieve this, the provider often “educated” their customers to inform them about the latest technological advancements and new functionalities of the equipment. The General manager (Case B) highlighted this: *“We*

*are all committed to try to visit all the hospitals in the regional bases and try to convince them that we have good equipment and a good service organization. (...) And then if their chief is interested, you try to come up with a proposal while visiting sites.”*

The PSS provider furthermore broadened its capabilities, insourcing new functions into the organization, to provide a one-stop solution for the customer, as the Service manager (Case B) explained: *“Now we want to sell consumables for [our equipment].”*

The PSS provider perceived multiple drivers to advance their service business. First and most important were the financial incentives to follow a servitization strategy. The service business was the *“butter on the bread”* (Sales manager) for the PSS provider. The financial incentives arose from the higher profit margins in the service business and the fixed amount of revenue that could be achieved, as the Sales manager (Case B) explained: *“We might not earn that much money in the direct sale; but, on the service contract, to know that for eight years we will have a fixed revenue, this is very attractive because this is where we earn our money.”*

In addition to the financial drivers, the PSS provider perceived other advantages, as the service business offered access to information about the operation of the equipment which benefitted the technological skill-set in the company and the innovativeness in its technological advances. This was particularly important to maintain the technical expertise of its service engineers, as the Sales manager (Case B) explained: *“It is important also for our service engineers to always have hands-on [experience] of the system because otherwise they will lose their competence.”* This included the control of the equipment to ensure safety, functionality, effectiveness and efficiency.

A third driver – besides financial and operational – was the environmental side of the service business. This focused particularly on energy use when operating the

equipment, as the General manager (Case B) highlighted: *“Not only with our equipment but all in all with the automation and the power consumption, that plays a major role.”*

This was especially the case where the provider drove the PSS development because of the implementation of regulations with regard to energy consumption. The provider was further investing to extend the life time of its equipment as it included updates in the service agreement, stating that *“after [a period] of two or three to four years, they get a master upgrade on each equipment. And then your system is as good as new.”* (General manager, Case B). This approach was very well received by its customers. Figure 3 shows the scheme for the business ecosystem for the provider-pushed PSS development.

**<Please insert Figure 3 about here>**

## **5. Discussion**

We found distinctive PSS development trajectories, which were strongly influenced by the business ecosystem. Table 3 summarizes the findings of the two cases. It seems that factors from the wider business ecosystem affect the drivers towards PSS development.

**<Please insert Table 3 about here>**

### ***5.1 The contingent effect of the business ecosystem and the PSS development***

The findings show that drivers from the business ecosystem (external drivers) can affect the adoption of a servitization strategy, as both regulations and level of investment affected the PSS development. This may be attributed to the industrial sector chosen for this research, as healthcare is highly regulated to ensure patient and staff safety, as well as very concentrated and demanding intensive investments. The findings suggest that environmental factors were important in both cases, confirming suggestions in the literature (Mont and Lindhqvist 2003).

One of the key differentiators between the two cases was the level of available investment specifically for the customers. In Brazil, public hospitals had experienced major cuts in the available funding for equipment, limiting the hospitals' ability to purchase large-scale equipment. As a result, the customer was not able to buy large equipment and, in turn, pulled the development of performance-based PSS. In contrast, in North Europe, the funding was readily available for purchasing equipment as well as services. This meant that hospitals had the necessary funds to purchase equipment, which led to a provider-pushed PSS development. Our findings thus indicate the core importance of the level of available funds in determining the PSS development. This finding adds to the literature, which has currently focused mainly on regulations as the main driver of PSS development (Mont and Lindqvist 2003).

Another important issue is that of environmental impact. As pointed out by Zhu et al. (2012), internationalization and international trade helps to diffuse cleaner technologies and environmental standards to production activities among manufacturers in developing countries. In Brazil, the main equipment providers are multinational companies with international cleaner standards for their equipment. In a complete PSS solution, the PSS provider can manage the final disposal of residues produced in the process of production.

In summary, the business ecosystem gave different incentives for driving PSS development. In Case A, the business ecosystem, characterized by the strongly-regulated public governance in Brazil and low level of investments, led to a customer-pulled PSS development, which is aligned with the customer drivers by the "*transfer of fixed costs into predictable variable costs*" (Baines and Shi 2015, p. 1178). The Case B context supported a provider-pushed PSS development, which confirms the central role of the provider (Kreye et al. 2013). As suggested by Kodama (2014), technology-

service convergence can evolve via different trajectories. The results highlight that, when customers pull the PSS development, the need for the operational and technological quality of the solution, as well as financial drivers and payment flexibility, are particularly important as they enable the operability and effectiveness of the system and ensure patient care. Similarly, when the provider pushes the PSS development, the financial drivers are central, in addition to access to information about the equipment operation.

### ***5.2 The drivers and PSS composition, roles and offering***

The two PSS development trajectories – provider push and customer pull – showed differences in the pace and stages in PSS development, suggesting different PSS evolution patterns. In Case A, customer pull encouraged agile responses to new procurement constraints that led to fast movement along the PSS continuum from product-oriented to performance-based. This fast PSS evolution demanded a combination of capabilities from multiple players where the contractual responsibility was related to the PSS provider. This path had significant challenges because the PSS provider had a short period to evolve along the transition line and develop the relevant service capabilities required to provide highly-complex performance-based PSS (Settanni et al., 2016). The evolutionary trajectory followed the four steps suggested by Oliva and Kallenberg (2003). In addition, the actors of the ecosystem had to maintain flexibility and a rapid pace of improvement (Williamson and DeMeyer 2012). Thus, the customer-pulled PSS development encouraged a fast process, which in turn led to the composition of the service system involving a network of providers. However, in general, the short timescale for developing customer-pulled PSS is a challenge for PSS providers without well-developed organizational readiness (Alghisi and Saccani 2015). In contrast, Case B showed a more classical servitization approach, in which the

provider pushed the PSS by shifting the value proposition to offering complementary services (Nemoto et al. 2015). This was a slower process, undertaken gradually and in stages (Tukker 2004) with the reported focus being on product orientation. Thus, the PSS provider had enough time to develop the relevant PSS capabilities in-house, which in turn reduced the need to include a large-scale network for PSS provision. The reason fact could be the provider push rather than the customer pull leading to a slower adaptation of the PSS concept within the business ecosystem and the possibility for the provider to develop the necessary capabilities to deliver the range of activities for more complex services.

## **6. Conclusions**

This paper set out to answer the RQs: RQ1: How do the customer and provider drivers for PSS affect the composition, offerings and roles of the PSS? RQ2: How does the business ecosystem affect the PSS development pathway in terms of favouring a provider-pushed or customer-pulled PSS development? Presenting in-depth evidence from two case studies in the Brazilian and Danish healthcare sectors showed the important role of the business ecosystem in motivating customer-pull or provider-push PSS development. Specifically, the level of investments available for the customer affected the PSS development. Low levels of investments caused a customer-pulled PSS development, characterized by a fast-evolutionary pathway towards a result-oriented PSS, and which resulted in the formation of a complex service system with a network of providing companies. In contrast, the availability of high levels of investment supported a provider-pushed PSS development, with a slow evolutionary pathway limited to product-related services, and which resulted in the formation of a service system with one PSS provider.

This paper provides strong implications for research theory and practice. We offer a rich description of the practice of PSS in the healthcare sector and equipment provider context contributing to the servitization literature in two distinct ways. First, we offer strong evidence of the contingent effect of the business ecosystem on the drivers of PSS development. Our research shows that the business ecosystem directly influences the drivers for PSS development, which affect the dependence of the actors in the BE, and the organizations' abilities to achieve the advantages of PSS development. The business ecosystem further affects the organizations' motivation to develop and adopt a specific PSS approach and servitization strategy and companies' abilities to adopt a specific PSS approach. Our research thus widens current descriptions in the literature from focusing on the dyad between PSS provider and customer to considering the impact of the business ecosystem. Second, the cases showed that PSS development affects the speed of adopting highly-complex PSS offerings between provider and customer. This work showed the roles that providers and customers play in driving PSS development which, in turn, supported the development of a complex service system with a network of providers (through fast customer-pulled PSS) or a complex service system with a single provider (through slow provider-pushed PSS). This adds to current discussions in the literature, which focus mainly on the providers' incentives to follow, or drive, a servitization strategy, however, has thus far neglected the determinants of service systems in servitization.

In terms of managerial implications, our research shows the practical differences between provider-push and customer-pulled pathways. The business ecosystem has strong implications for the level and speed of PSS adoption on the market and thus the providers' (and customers') abilities to achieve the potential benefits of servitization. The short timescale for developing customer-pulled PSS offers a strong challenge,

because servitization requires in-depth organizational change and the building of capabilities in order to succeed. Here, co-development approaches together with the customer may be preferred over in-house PSS development processes. We also showed that PSS providers need a different set of capabilities, depending on the PSS. Providers facing customer-pulled PSS development need capabilities to manage and integrate the individual offerings of various companies within the PSS network. In contrast, providers in contexts favouring provider-pulled PSS development need service capabilities in order to manage the complex operations involved. This understanding will guide managerial decision-making when following a servitization strategy, as resources can be deployed to develop either technological and service capabilities to offer the PSS solution in-house or to create relational capabilities to navigate and guide the PSS network and deliver added value to the customers.

This research also has strong implications for public policy in creating an environment that supports PSS development in accordance with Adaku et al. (2018) and Ehie and Muogboh (2016) studies. As such, policymakers can intentionally create an environment that encourages fast PSS development and incentivizes providers and customers to achieve the benefits of following a servitization strategy. This may allow policy makers to achieve policy goals that are supported by servitization, such as environmental and economic benefits. Specifically, the encouragement of customer-pulled PSS development can encourage fast PSS development trajectories, which in turn may support sustainability targets through the environmental benefits of servitization.

There are some limitations to this study we need to acknowledge. Even though this aspect is usually mentioned for quantitative case-based studies, the research results need to be interpreted in light of the cases specific contexts, considering two cases in a particular sector, the healthcare industry, in two countries; thus the results have limited

generalization. However, it brings real market reports that can be used as guidance insights for academy and managers. Additionally, it is relevant to mention the respondent and research bias that can influence qualitative approaches.

This research points towards important areas for further investigation. Future work on the role of the business ecosystem and the ability of policymakers to deliberately influence PSS development trajectories is needed. Our findings suggest a fundamental difference between developed and developing economies in creating business ecosystems for PSS development. For future studies, it is suggested that the sample of analysis should be widened to other relevant contexts, and then the findings could be further strengthened and development of the PSS pathways. Second, future research agenda need to include a broader investigation of industrial sectors to identify and analyse the characteristics of these settings and their impacts on driving PSS pathways. This research focused on the relatively highly regulated healthcare industry sector with typically large providers. Other sectors may show different effects of business ecosystems on PSS development and thus offer complementary insights, such as niche technologies that may be provided by SME, configuration different ecosystem dynamics. Third, an in-depth investigation of the role of different players in the business ecosystem should be investigated.

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