



Academic

INTERNATIONAL WORKSHOP ADVANCES IN CLEANER PRODUCTION

“TEN YEARS WORKING TOGETHER FOR A SUSTAINABLE FUTURE”

Different paths for sustainability through PSS

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Abstract

Pressures from globalization lead manufacturing companies particularly in the healthcare sector to increasingly incorporate services into their offerings. They shift their core business processes to become solution providers such as Product-Service Systems (PSS) and create value for their customer base. This shift has also been termed servitization. The focus is often on business-to-business (B2B), where the PSS provider maintains and ensures operability of the equipment for a customer organization. Business models for PSS usually grow around the physical asset, which can be owned by the PSS provider who offers the asset's use or owned by the customer who requests additional support for the asset. Value is added through ensuring the product performance and availability. Product-service Systems (PSS) increasingly characterize sectors with public-private partnerships such as healthcare. The adoption of such PSS can vary depending on the contingency of the business environment favoring different levels of servitization adaptations. This paper investigates how the pressures from the business environments constitute drivers for PSS development. The paper presents evidence from two case studies set in the healthcare industry in Brazil and Denmark. The presented data includes semi-structured interviews with managers and engineers involved in the PSS as well as secondary data. This paper shows that the business environments in the healthcare industry are characterized by increasing level of regulation and differ in their level of investments that determine whether the PSS development is customer pulled or provider pushed. The customer-pull in Brazil led to a quick adoption of result-oriented PSS while the provider-push in Denmark was characterized by a slower adoption of product-focused PSS. Both cases showed different levels of economic, social, environmental and operational issues. This paper contributes to current literature by understanding the different paths of PSS development is enhanced by explaining the drivers for providers and customers to engage in a servitization strategy and develop the required capabilities to be successful in this business opportunity. The most important drivers identified financial, operational and environmental.

Keywords: *Product-service system; case study; environment; healthcare.*

1. Introduction

Pressures from globalization lead manufacturing companies particularly in the healthcare sector to increasingly incorporate services into their offerings (Baines et al., 2009). They shift their core business processes to become providers of solutions such as Product-Service Systems (PSS) and create value for their customer base (Davies et al., 2007, Johansson and Olhager, 2006). This shift has also been termed servitization (Baines and Lightfoot, 2014). The literature in the field focuses on

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São Paulo – Brazil – May 24th to 26th - 2017

drivers from the cooperating companies, i.e. PSS provider or customer, to deliver or receive solutions. For example, the literature often describes three main drivers for servitization: economic, environmental and social (Kuo and Wang, 2012). Economic drivers focus on the desire to increase revenue, stabilize cash flow and improve the company's market share (Baines et al., 2009). Environmental drivers suggest that PSS can extend the life cycle of technological equipment and decrease the use of resources such as electricity through optimizing operations, thus improving the environmental sustainability of the equipment (Rocha et al., 2007). Social drivers focus on the customer interaction allowing for an improved ability to satisfy customer needs and develop close links (Baines et al., 2009).

Despite these insights, the current literature lacks insights into national differences in the market environments and local incentives to provide or receive PSS. In particular, servitization can be driven by the PSS provider or by the customer depending on the business environment. As following a servitization strategy is a response to external stimuli resulting from incentives such as market pressures and competition, it is the national business environment that drives the organizational adoption of the PSS concept in both providers and customers. As such, the national environment in terms of economic, legal and social drivers needs to be considered in the discussion of PSS. However, the current literature offers little insights on the influence of these national differences on servitization strategy of PSS providers and their customers, focusing largely on internal processes within the companies. Specifically, the literature to date focuses on issues regarding the dyadic relationship between PSS provider and customer (Durugbo, 2013), the design and management of PSS through the life cycle (Shen et al., 2012) and the support of decision making in the procurement of PSS (Song et al., 2013). A significant gap exists in the literature with regard to the influence of national business environments on the adoption of PSS.

This paper aims at identifying different paths of PSS development is enhanced by explaining the drivers for providers and customers to engage in a servitization strategy and develop the required capabilities to be successful in this business opportunity.

2. Methods

To achieve the objective proposed, we present two case studies in the healthcare industry, favouring customer driven and provider-driven servitization respectively. The cases are set in the Brazilian and Denmark healthcare industries. Case-based research is the most suitable research method for our RQ as it allows to study the impact of external conditions on internal reactions (Eisenhardt and Martin, 2000). Furthermore, there is limited extant theory explaining the investigated phenomenon as demonstrated in Section 2. Thus, there is a need for exploratory research to develop new insights and understanding (Karwan and Markland, 2006) and build theory (Smith et al., 2009). Third, the investigated phenomenon is context-specific, focusing on the influence of the national environment. Case study research is a suitable method to gather practical insights into the issue (Flyvbjerg, 2006) and offer an in-depth discussion to identify the empirical evidence needed to extend current theory (Siggelkow, 2007).

The cases were selected based on the drivers of the PSS development in the national context. We strategically selected one case where the national environment favored a customer-driven and the second case for the provider-driven implementation of servitization. Thus, we can compare the environmental settings and the influences on the processes and relationships within PSS setting. The data was collected with semi-structured interviews with PSS providers and customers in Brazil and Denmark respectively. Table 1 depicts the interviewees for both cases. The discussions focused on characterizing the business environment and recent developments, the business and operation strategy as well as the relationship between the PSS provider and customer. The interviews were recorded and transcribed. The study findings were presented back to the solution provider post-analysis to obtain feedback and comments. This ensured the rigidity of the obtained 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 (Lewis and

Grimes, 1999). The collected data was analyzed qualitatively through iterative coding based on the researchers' understanding of the cases and the literature.

	Case A	Case B
National setting	Brazil	Denmark
Drivers	Customer driven	Provider driven
Interviewees	Laboratory Director Chief physicist Administrator Technician 1 Technician 2 Technician 3 Technician 4 Technician 5 Technician 6 Technician 7	General manager Service manager Business strategist Sales manager Business controller Administrator 1 Administrator 2 Service engineer 1 Service engineer 2 Service engineer 3

Table 1. Interviewees of Case A and B.

3. Results

In this section, we compare the findings of both cases in terms of the national environments leading to customer-driven and provider-driven PSS development in Brazil and Europe respectively.

3.1 National environments in the Brazilian and Denmark healthcare industry

The national environments of the Brazilian and Denmark healthcare industry can be characterised in six main points: the regulation of the relationship between PSS provider and customer, the level of investments into the public healthcare sector, the customer's ownership for the equipment, the drive towards technological advancements, the customer's interaction with the equipment and the need for service support. In both environments, Brazil and Europe, an increasing amount of regulations in the healthcare system have been observed that defined, for example, the level of patient care and safety, introduced a formal tendering process and defined the interaction between PSS provider and customer. In Europe, this has increased the level of complexity of the interaction between the provider and the customer as the Sales manager (PSS provider, Case B) explained:

"If you look 25 years back, I could go to a customer and sit down with him in his office. And when I was gone, we had settled the deal. (...) And maybe there were two experts, the professor, and the engineer of the hospital together with me. Nowadays, you have a bunch of people you need to address from the strategic purchaser to the medical, technical advisor to the consultant. (...) *you need to approach everybody; you need to be able to speak to everybody in order to position yourself the best way.*"

The same situation happens in Brazil once the bidding process is complex, longstanding, and demands specific resources on PSS providers and customer side. It involves a multidisciplinary team, starting with the technical areas (Clinical Biochemistry, Molecular Biology, Parasitology, etc.) to identify and describe customer's needs (because each exam is held during a contracted period). Purchase department to consolidate technical information and assembles the bidding process in accordance with the law. Business department to prepare and analyze proposals. The laboratory director (Customer, Case A) explains "[...] it takes months for description; it is necessary to describe every single detail."

The provision of effective and quick healthcare is a priority in the studied Denmark country. This was

accompanied by investments into the healthcare system to develop new infrastructure, erect new hospitals and purchase new equipment. This development was still going on during the time of the interviews as the General manager (PSS provider, Case B) highlighted: *"they are going to build 16 new hospitals in [Region A], investment of €5.6 billion and of course it's a major issue."* In addition, further investments into the acquisition of new equipment had been done as the Business controller (PSS provider, Case B) highlights: *"And it's not many years ago that the [piece of equipment] was installed and now it's in each hospital."*

This level of investments has two implications for the businesses. First, the customers in Europe place high importance on owning the equipment. This has led to an increase in the product sales over the recent years as well as a benefit for the support service part of their organisation as the Business controller (PSS provider, Case B) clarified: *"There has been a huge growth in the in-store base the last years and we in the service organisation (can see the) a profit now from this. We have to support and make service on our in-store base."* So currently, the Denmark PSS provider does not see a need or possibility to establish an integrated solution of use oriented or result oriented Product-Service Systems. The Sales manager (PSS provider, Case B) commented on this as follows: *"This may be that because of cost aspects this will change; but it will not change in my time. So for the time being, we are not considering this."* Second, the high level of investment means that the customers drive towards acquiring the latest technological advancements in their purchases. The customer asks for the latest functionalities of the equipment, driving the use of new parts. *"It's technology-driven"* (Business controller, PSS provider, Case B) *"They are very new, (...) they are one of the most advanced centres in Europe"* (General manager, PSS provider, Case B). This pushed the level of innovation within the PSS provider, focusing particularly on technological advances, as highlighted by the Sales manager (PSS provider, Case B): *"this pushes also the research department and the development department to always come up with new products or new ideas, create new possibilities."* This has led to a world-wide leading position of one of the customer hospitals as highlighted by Service engineer 3 (PSS provider, Case B): *"we were actually the first place all in the world to do (...) this system so they have also been included in the development of the units."*

In addition to purchasing the equipment, the customer also retains some service capability to enable them to do first-line services themselves. This aims at giving fast support when it is needed, for example when the equipment breaks down. The service manager (PSS provider, Case B) clarified: *"they think they can save money and have better availability of the equipment."* The customer's challenge, however, is that they own equipment from different providers posing difficulty in technological training for their staff to deal with issues beyond the first-line. Thus, there is still a high need for service support from the PSS provider due to the high level of technological advancement. Thus, the service business is a core part at the equipment purchase, as highlighted by the Service manager (PSS provider, Case B):

"You cannot sell a product without service agreement. The customer can choose different levels and say, "Okay, we have also a certain know-how in-house and provide first line service and you only have us to provide second line." But, there will always be a kind of service agreement attached."

In summary, we observed the following differences. The Brazilian sector is characterised by a complete PSS solution demand, pushed by customer needs and regulation environment. Equipment is very expensive and unlike Denmark market, Brazilian customers have a reduced funding to acquiring equipment. Considering that this equipment is imported from other countries once there is not enough demand to manufacture it locally, there is also high import taxes added to final price. It brings a huge implication to the technology aspect, once it almost prevents customers to follow technological advances. The purchase of a complete solution, as explained by Chief physicist (Customer Case A): *"it was the way to avoid labs scrapping."* With the purchase of a PSS solution, laboratories can renew their equipment because PSS provider is highly interested in offering the latest machines and replace them at no charge in the event of a technical improvement of the equipment. As PSS provider is paid by customer's system production, if it is more efficient he earns more.

In contrast, the Denmark healthcare industry is characterised by a high level of regulation concerning the relationship between PSS provider and customer, leading to more complex interactions. Furthermore, the Denmark sector has experienced high amounts of investments in hospitals and

equipment which led to the fact that customers want to own the equipment and place high importance on the technological advancement of the equipment. In Europe, customers still maintain some service capabilities themselves and place high value on the service support they can receive from PSS providers beyond this first-line service capability. This led to the observation that the PSS development is customer driven in the Brazilian healthcare industry while it is provider driven in the Denmark healthcare sector.

3.2 Customer drivers for PSS development

Customers' demands (financial and technological) in the Brazilian healthcare market pushed providers to offer a complete solution. PSS development evolved along years, first, it was characterised by the product focus. However, due to government regulations, funding reduction, equipment architecture and customers' processes, today it has changed to a full PSS solution.

This scenario is more visible in the public sector, where regulation is complex and operational volume higher.

In the early 1980s, hospitals bought clinical analysis equipment, which became their property (assets). Equipment was very expensive, and maintenance was contracted in a separate contract. Inputs (e.g., diagnostic kits) could be acquired from the equipment supplier or any other source, what Chief physicist (Case A) called: "open architecture".

There was also the issue of the seasonality of funds provided by the state government in addition to specific targets; capital funds could not be used for services, and vice versa. This fact led to situations in which during some periods the lab had equipment but no inputs, and other periods in which inputs were available but the machinery broke, and there was no money for maintenance. In some cases, the machinery worked properly and the inputs were available, but the system that supplied water treatment equipment was broken. Another important issue was the distribution of funds for the acquisition of material goods (assets) that, over the years, had been frozen by the state government.

Hospital needed to address multiple suppliers (equipment, materials, and other peripheral systems) and maintain multiple contacts within the same supplier (sales, maintenance, technical).

Over time, these factors made it difficult to maintain the clinical analysis service because internal processes became more complex, slow, and, in some cases, ineffective. In parallel, the equipment industry continued to develop new diagnostic machines, but at a very high price.

In the early 1980s, government allowed public agencies to lease equipment. Leasing equipment contracts were established in which the supplier offered the diagnostic machine, which remained the manufacturer's property. Inputs could still be acquired from any supplier. Maintenance was included in the leasing contract, which also contained other components, such as clinical testing procedures (for example, the water purification system). The contracts were for five consecutive years, a requirement imposed by the selected vendor as a way to amortize the equipment purchased. At the end of the contract, the supplier removed its equipment hospital, which no longer needed to take care of the complex disposal of this equipment.

An important driver is sustainability as reduce the environment impact is a challenge to laboratories and it also led to a complete PSS solution as pointed out by Laboratory Director (Case A): "*Depending on the solution agreed, provider is also responsible for final disposal of residues produced in the process.*"

3.3 Provider drivers for PSS development

The developments in the national environment in the Denmark healthcare industry led to a provider driven PSS development, which is characterised particularly by the product focus of the businesses. The PSS providers ensure their competitive advantage particularly through their technological advancement of their equipment, which drives their product-focus. The general manager (PSS provider, Case B) confirmed this: "*I think that they got trust in our products. (...) he is confident that*

he gets what he was looking for.” The service business is organised around the equipment to ensure the operability and the high level of technological advancement for their customer. Thus, the PSS provider uses their service business to increase their product and part sales, as the Service manager (PSS provider, Case B) explains: “If they want some new applications, they want maybe the new software, (...) this perhaps also include new hardware. (...) Therefore, it is not only maintenance. It is also to have the equipment (...) at the state-of-the-art performance.” To achieve this, they often “educate” the customer to inform them about the latest technological advancements and new functionalities of the equipment. The General manager (PSS provider, 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 organisation. (...) And then if their chief is interested, you try to come up with a proposal while visiting sites.”

The PSS provider perceives multiple drivers to advance their service business. First and most important are the financial incentives to follow a servitization strategy. The service business is the “*butter on the bread*” (Sales manager) for the PSS provider, as the General manager (PSS provider, Case B) highlights:

“we have doubled the turnover and we have very much more people so we have pushed the economy of scale. (...) It fits very closely into the entire business model. Services are very important, actually the core part of our healthcare business.”

The financial incentives arise from the higher profit margins in the service business and the fixed amount of revenue that can be achieved with the business, as the Sales manager (PSS provider, Case B) explains: “*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 perceives other advantages of the service business. It offers access to information about the operation of the equipment, which benefits the technological skill-set in the company and the innovativeness in their technological advances. This is particularly important to maintain the technical expertise of their service engineers, as the Sales manager (PSS provider, Case B) explains: “*it is important also for our service engineers to always have hands-on on the system because otherwise they will lose their competence.*” This includes the control of the equipment to ensure safety, functionality, effectiveness and efficiency. As such, the PSS provider prefers to have control over the complete process involved in installing and operating the system, as the Sales manager continues his explanations: “*we like also to take care of the preparation of the room because then we can govern the whole installation time frame. If we take responsibility from A to Z then we can control pretty much everything.*”

A third driver for the PSS provider – besides financial and operational – is the environmental side of the service business. This focuses particularly on the energy use when operating the equipment, as the General manager (PSS provider, Case B) highlights: “*Not only with our equipment but all in all with the automation and the power consumption, that plays a major role.*” This is especially where the provider drives the PSS development due to the implementation of regulations with regard to energy consumption. They are further investing to extend the lifetime of their equipment through two approaches. First, they include updates into the service agreement that include 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, PSS provider, Case B). Their customer base has received this approach very well. In contrast, the second option is to refurbish and reuse some material from existing equipment. Here, the PSS provider experienced some difficulties in implementing their environmentally friendly solutions with their customers, as the Sales manager (PSS provider, Case B) explained: “*They want the best for sure. You cannot go to a customer and say, ‘Okay, this is a refurbished system.’ If it is not state of the art, forget it.*”

4. Conclusion

This paper provides 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 effect of the business context on the PSS development. This shows that developments of the business context are a direct influence on the PSS development and defines the organizations’

abilities to reach the advantages of PSS development. It further influences the organisations' motivation to develop PSS and follow a servitisation strategy and on companies' abilities to adopt a specific PSS approach.

This research also has strong implications for public policy in creating an environment that supports PSS development. As such, policymakers can intentionally create an environment that drivers for fast PSS development and incentivizes providers and customers to achieve the benefits of following a servitization strategy. The most important drivers identified financial, operational and environmental.

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