Managing Innovation Processes: The Case of Integrated Product-Service Systems

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Abstract: Most research on the management of innovation processes has focused on either new product development or new service development, while the development of new integrated product-service systems has received limited attention. This paper addresses this literature gap by exploring qualitatively how new integrated product-service systems are developed in five firms. The findings demonstrated that there is not one specific process that is implemented and used in all new product-service system development initiatives. Instead the characteristics and the management of the new product-service system development processes were found to be contingent upon both the type of services (smart digital services vs. traditional services) and the business model (product-oriented services vs. result-oriented services). These findings provide considerable guidance to managers searching for ways to manage the processes of developing new product-service systems. Further research is needed to verify if the same contingencies are found in other types of organizations.

Keywords: Innovation processes; product-service systems; servitization; new product development; new service development; product innovation; service innovation.

1 Introduction

To grow revenues and profit (Eggert et al., 2014) and sustain competitive advantage (Durugbo, 2014), an increasing number of manufacturing firms now deliver integrated product-service systems (PSS) instead of pure products (Lightfoot et al., 2013). The phenomenon of creating new revenue streams "*by adding services to products*" (Baines et al., 2009, p. 547) is often referred to as the servitization of manufacturing. Empirical research has documented that the transition from product- to service-oriented business models is very challenging for firms, and that organizational dimensions such as culture, structure and strategy need to change during the transition process (Baines and Lightfoot, 2013). Research has also acknowledged that servitized firms need to implement innovation processes that are different from those of pure product firms (Parida et al., 2014). Since servitized firms offer integrated product-service systems they need innovation processes for both products and services (Zhang and Banerji, 2017). Research on the characteristics of new product-service system development processes and how they are managed has, however, until now, remained scarce. According to Zhang and Banerji (2017) this knowledge gap is a challenge for innovation managers in servitized firms.

In this paper we, therefore, aim to empirically explore how PSS innovation processes are implemented in servitized firms. The following research questions are raised: 1) What are the characteristics of new product-service system development processes? 2) How are new product-service system development processes managed?

To address these questions, we conducted a qualitative study of the product-service system innovation processes in five firms delivering technologically advanced product-service systems globally to the energy and maritime sectors. In the next section we review the literature on innovation processes. Thereafter we describe the research method. The empirical results are presented in Section 4 and in Section 5 we discuss the results and conclude.

2 Theory

Innovation processes

Research on the management of innovation processes has typically focused on either new product development (NPD) (Cooper, 2008) or new service development (NSD) (Hipp and Grupp, 2005), while the development of new integrated product-service systems (PSS) has received limited attention (Zhang and Banerji, 2017). Empirical and conceptual research on NPD processes has a particularly strong tradition. Empirical findings from NPD research indicate that top-performing firms typically use structured and formal idea-to-launch systems, such as Stage-Gate, to manage their NPD processes (Barczak, Griffin and Kahn, 2009). Idea-to-launch systems, such as Stage-Gate, may be understood as "*a conceptual and operational map for moving new product projects from idea to launch and beyond*" (Cooper, 2008, p. 214). Recent NPD research suggests that modern idea-to-launch systems are "*more dynamic, flexible (...), adaptive and risk based*" (Cooper, 2014, p. 21) than the original Stage-Gate systems, but that the core ideas related to dividing the process into stages and gates, remain the same.

Recent research on NSD processes, however, suggests that the recommendations provided by NPD research are not necessarily transferable to the NSD domain (e.g., Aas et al., 2015). Empirical NSD studies have for example found that NSD processes are typically more incremental, iterative and ad-hoc than NPD processes (e.g., Hipp and Grupp, 2005), and as a consequence service innovation scholars have argued that *"seeking to define steps for the process of creating new services is even more arbitrary than in manufacturing"* (de Jong et al., 2003, p. 34) and that firms need to implement different processes for NSD and NPD (Droege et al., 2009). This recommendation is reasonable in cases when services and products may be separated, but more problematic in servitized firms that offer integrated product-service systems (Zhang and Banerji, 2017). Thus, more research is needed on new product-service system development processes (Zhang and Banerji, 2017).

Product-service systems

A product-service system (PSS) may be defined as *"an integrated combination of products and services"* (Baines et al., 2007) or more specifically as *"tangible products and intangible services designed and combined so that they jointly are capable of fulfilling specific consumer needs"* (Tukker, 2004, p. 246). Both the services offered and the business models that are utilized may vary in PSSs.

In the context of PSSs, the literature often distinguishes between traditional services and smart digital services, where smart digital services *"go beyond the kinds of up-keep and upgrades you [firms] may be bundling with your [the firm's] products, both in their value to customers and in their cost efficiency to you [the firm]"* (Allmendiger and Lombreglia, 2005, p. 1). When firms provide smart services, they build sensors, connectivity and data analysis capability into the products, enabling them to act on results of data analysis (Allmendiger and Lombreglia, 2005). Traditional services are services offered without utilizing digital services in this way.

Tukker (2004) place different business models used in PSSs on a continuum. The outliers on this continuum is the so-called product-oriented business model and the result-oriented business model. The product-oriented business model is *"mainly geared towards sales of products, but some extra services are added"* (Tukker, 2004, p. 248). The result-oriented business model, on the other hand, does not focus on the sales of products. Instead *"the client and provider in principle agree on a result, and there is no pre-determined product involved"* (Tukker, 2004, p. 248).

3 Method

Since qualitative research arguably has advantages when the phenomenon to be studied is not well understood and where the variables are still unknown (e.g., Johnson and Harris, 2003), we used a qualitative multiple case study approach (e.g., Yin, 2003) to answer the research questions raised in this study. To enable selection of case organizations that offered opportunities to learn and build theory about new product-service system development processes, and to get a preliminary overview, we first had a dialogue with the management of a business cluster of leading firms within the Norwegian energy and maritime sector.

Based on this dialogue five servitized firms were selected as case organizations. The companies came from different parts of the industry value chain and the degree of service

orientation in the firms varied. The first firm, Alpha, offered advanced engineering and construction services for customers in marine industries. The second firm, Beta, was a leading supplier of drilling equipment and services for customers in the oil industry. Gamma, the third firm, was a leading supplier of advanced, heavy lifting equipment and services especially for customers in the marine industries. The fourth firm, Delta, was a niche supplier of high-end operator chairs and related services for customers in marine and aviation industries. Epsilon, the fifth firm, was a supplier of lay flat hoses and related services for customers in many different industries.

All firms had a strategic focus on innovation and had several ongoing new product-service system development initiatives in their innovation portfolios. Data related to how new product-service development processes were implemented in the case organizations was collected through semi-structured in-depth interviews with in total 43 key-informants. To reflect the overall development processes, between seven and eleven employees with different roles and from different levels of the firms were interviewed in each firm. The interviews were recorded and transcribed. The data was coded and analysed in an inductive manner by performing both within-case and cross-case analysis.

4 Findings

All case organizations provided a high number of examples of new product-service systems that had recently been successfully implemented or launched in the market. The examples varied both with respect to the types of services offered (smart digital services vs. traditional services) and with respect to the business model used (product-oriented services vs. result-oriented services). Three different combinations of business model and services offered were identified in the case organizations: (1) product-oriented business model and traditional services, (2) product-oriented business model and smart digital services, (3) result-oriented business model and both traditional and smart digital services.

Our findings suggested that the characteristics and the management of the new product-service system development processes varied in the three situations. The characteristics and the management of the new product-service system development processes found in the three situations are exposed below:

Product-oriented business model and traditional services

Although most firms in our sample had an ambition to deliver smart digital services and transform their business models from product-orientation towards result-orientation, the combination of product-oriented business models and traditional (after-sales) services was still dominating in most case organizations. One top manager in Beta for example explained:

> "Traditionally, service offering in our firm has consisted of sale of spare parts
> and service engineers that travel to the customer's rig and repair the equipment.
> It used to be a quite small part of our business, but the sale of spare parts and
> the sale of service engineering services grew quite a lot until 2012."

Another informant, a manager responsible for after-sales services in Gamma, explained:

> "So, in principle we [after-sales] take over the products after our product development department have built them and delivered them to the customer. (…). We provide services such as spare parts, technical support services. We also help the customer if he needs to do technical changes to the equipment, extend the equipment's lifetime and many such things. We also offer training in a simulator. And we also have a 24/7 agreement with the customer. They can call us and ask for help."

When developing product-service systems with product-oriented business models and traditional (after-sales) services the products and services were developed by two separate teams, one product team and one service team, with little interaction. This was the case in all case organizations in our sample. One manager in Gamma for example explained:

> "We [the department of after-sales services] and the department of product development are in different 'silos'. (…) Normally the product development department just deliver the new equipment, for example a new winch, to the customers. Then it is up to the customer later to look at what type of services they need to operate and maintain the equipment. It varies what the customers want from us. Some just don't want to touch the equipment, others want to do everything themselves. (…)"

Formal systems were typically used to manage the idea-to-launch processes of the NPD processes. One top manager in Epsilon for example described the NPD process in this way:

> "When we develop new products, we do a real business case and see whether this is financially justifiable, that is, paybacktime and such things, and during the development process we use a stage gate system (…)."

The NSD processes, on the other hand, were typically managed in a more informal ad hoc manner often with strong interaction with the customers. One manager from Gamma for example explained:

> "Even if we deliver the equipment to the yard and have a contract with the yard, we also have a connection to the end-users of our equipment. Especially, we get a good connection with them when we provide training services. Then the end-user come to us. (…). This is very valuable for us. The instructor of the course gets a lot of information from the end-users about how we can "support" them and such. It is incredibly important for us to get this information and we use it to develop new services. But there is certainly a greater opportunity than what we use today. (…)"

Product-oriented business model and smart services

We also found several examples in the case organizations on product-service systems combining product-oriented business models and smart services. One illustrative example here was the so-called "on watch" services delivered by Gamma. One manager explained:

> "On the advanced cranes that we deliver we have an online system. We offer what we call an 'on watch' contract. It is a bit like this: If the customer calls in and have problems and need help with a crane, then we can connect to the crane, download information and be online with the crane when the customer run their operations. We can run diagnostics to find out what is causing problems and come up with solutions (…)"

When developing product-service systems with product-oriented and smart services the development process was typically run as an integrated process with one team of digital technology and service experts. A top manager in Gamma for example explained:

> "We have established a separate R&D group centrally in [name of the firm – anonymized] responsible for digitalization. We have moved most of our digital experts into that group. This group was responsible for the "on watch" development project (…). They also run many other development projects. MDR is one example (…). This system transfers critical data from the vessels to a central hub (...)."

Service experts were also involved in the development process. One manager from the after-sales service department in Gamma explained:

> "The "on watch" project was run by the R&D group in [name of the firm – anonymized], but we [the after sales department] also had a role in the project (…). My role in this context was mostly guidance. I tried to suggest smart solutions. We were involved in all three design reviews that were run in the project (…). One of the reviews was a reference review and quite elementary stuff, but there were a lot of things to remember and perhaps the engineers [in the R&D group] have not been involved in operating the equipment in practice; hearing sounds (…) and lots of stuff. We also gave advice related to maintenance. Are these bolts available? Are you able to dismantle the equipment? Is it sensible to change these components and what components is it sensible to change in that case? (…) Then of course there is operation. I was on a rig earlier and incredibly impractical to have those buttons 'there' and it seemed intuitively wrong. So, we provide input to the R&D group on such things (…) We also provide our inputs related to the use of sensors. It is almost like if you increase the number of sensors, you increase the number of errors as well. (…) Do we need more sensors or a different configuration of sensors? We do not always need more; it can actually be fewer. We have experienced that (…). It is often the connection between sensors that is important. Not the number of sensors (…)"

We also found that formal systems were typically used to manage the idea-to-launch processes when developing new product-service systems with product-oriented business models and smart services. A manager in Gamma for example explained:

> "The R&D group runs projects, such as the on-watch project, through a so-called PEM model, a Project Execution Model, where the project is guided through several stages (…)".

Result-oriented business model and both traditional and smart digital services

Most firms in our sample had an ambition to transform their business models from product-orientation towards result-orientation. This ambition was driven by a belief that it is easier to secure competitive advantage if the firms are able to build long term relationships with customers. In practice, such result-oriented business models in the case organizations included both traditional services and smart digital services. A top manager in Gamma explained:

> "If you are a pure equipment manufacturer it is difficult to make money. You earn very little. Those who make money today are those who deliver software or pure services where you have the entire "life cycle" of the product. They often deliver "hardware" too, but at a relatively low price, and they serve the customer throughout the lifetime. They build a strong customer relationship,

and their revenue is much more predictable than our revenue. Certainly, if you get the products digitized in a good way and you can offer services and to a great extent sit and monitor the equipment for the customer, then it is clear that you get the aftermarket too. It's really important."

Even if the ambition to provide all services (both traditional services and smart digital services) through result-oriented business models was present in most case organizations, we only identified a few examples of such business models already implemented by the case organizations. One example was identified in Beta. This firm had recently established a long-term result-oriented full-service contract with a rig operator utilizing digital technology. A manager in Beta explained:

"It is a contract with a lot of small print, but in a simplified way it can be explained like this: The customer gets a fixed price and an up-time commitment from us for ten years. Against that they get a discount of 20%. And then we get penalty if the downtime is too high and bonus if the customer gets higher earnings. The penalty and bonus elements are not so difficult, but it does show that the intention is that they [the customer] have the rig available as much as before or more. And they have got a 20% discount and if we do more than that, we have an upside. So, if we, through utilizing modern digital systems, manage to spend less on maintenance than the 20%, we have given in a discount, then we have an upside. So what was brave and cool with [our customer], which the other actors in this market have not come to yet, it is that they say that 20% is okay, (…) while the other fumbles around and wonder if they give too much, for maybe it should have been 22%, right. And we don't know these things either. Because we have only had two years in the agreement (...)"

When developing product-service systems with result-oriented business models the development process in the case organizations was divided in two parallel, but related, processes. One process was aiming to develop technology that enabled the firms to offer long-term life cycle services in an efficient manner. The other process was aiming to develop the business model itself, including the contractual regime, supporting the provision of services during the entire life cycle. The first process was characterized by the use of cross-functional teams with digital technology, service as well as product experts. The second process was characterized by the use of skilled business and contractual experts and close collaboration with the customer.

One top manager responsible for digitalization in Beta explained how the enabling digital technology was developed:

"I [the digitalization department] am responsible for developing digital technology, (…) but it is another part of the organization [the aftermarket division] that (…) provide the services. Before [when we used product-based contracts] it was just about sending out a man with a coverall, and our role was to make technology that was useful for him (…). Now with result-oriented business models we work much more in collaboration than before. So that's a big change. (…) However, we have not yet collaborated so much with the new product development department. (…) This is because the volume of new rigs is so small now. Until now we have entered existing rigs. And then that's what it is, what's out there. (…) But it is clear, they [the product development department] will learn a lot from what we do, to understand what the problem with the equipment is. They will learn that we have some machines that are practically impossible to destroy, so the customer doesn't really care. And they are going to learn that other things are broken unexpectedly quickly (…)."

Other informants provided similar descriptions. A top manager in Gamma, for example, reflected like this:

> "I think it is completely wrong to distinguish after-market services and new product development. It might have been correct before when it was a much larger volume and the oil companies queued up and called for spare parts, but now that you are moving more and more towards a "life cycle race" then it is clear that you have to gather the value chain in one organization."

Regarding the development of the business model and the contractual regime, the manager in Beta responsible for this process described the process in this way:

> "This was a process that started 3 years ago, where we really came up with an approach to them [the customer]. [The customer] bought [another company], which had two drilling vessels under construction in the Far East. Those ships were the first ones we actually delivered with logging technology, that is technology that allowed us to collect data. A strategic decision was made that we should deliver on those projects and that made it possible for us to do a lot of things. So, we started the dialogue with [the customer] about how we could get this and how we could do something together here. (…) Then [the customer] came back and said that they had made a strategic decision and wanted to find the best business model for the future. They had done a process internally where they had written up on the board what was their aim and their suppliers' aim, and it didn't fit at all. So, they wanted a business model that put us in the same chair really.

Formal systems were typically used to manage the idea-to-launch processes resulting in result-oriented business models. However, the process also had agile elements. One manager in Beta for example explained:

> "We have learned a lot from being agile and working close to customers".
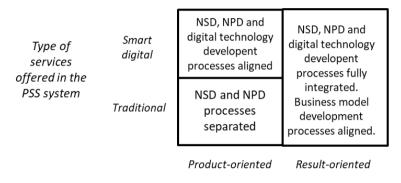
5 Discussion and conclusions

Theoretical contribution

By using comprehensive qualitative case study data from five servitized firms, the paper contributes to the ongoing debate related to the characteristics and management of new product-service system development processes (Zhang and Banerji, 2017). Our findings advance this debate in two ways.

The first lesson resulting from our findings is that new PSS development is not only about NSD and NPD. In the case when firms offer traditional services through product-oriented business models it is true that new PSS development is mostly about NSD and NPD, but when the firms start offering smart services and start transforming their business models, new PSS development is also about development of new digital technology and development of new business models. Thus, innovation in the context of PSSs is more complex than anticipated by prior research (e.g., Zhang and Banerji, 2017).

The second lesson resulting from our findings is that the characteristics and management of these development processes in the context of PSSs are contingent upon the business model and the type of services offered. In PSSs where firms offer traditional services through product-oriented business models NSD and NPD processes are separated. However, when firms offer smart digital services through these product-

oriented business models the development processes are more aligned, and when they transform to result-oriented business models the development processes become fully integrated. The characteristics of smart services and result-oriented business models may explain these differences: The offering of smart digital services require development of new technology and often modifications of the products (Allmendinger and Lombreglia, 2005), and the implementation of result-oriented business models require that the firm is able to see the link between products, services and how the customer uses the product (Tukker, 2004).

The two main lessons resulting from our findings are illustrated in Figure 1.

Figure 1 Characteristics of new product-service system development processes.

Practical implications

The practical experiences reported in the paper provide considerable assistance and guidance to managers searching for better ways to manage the processes of developing new PSSs. The findings demonstrate that there is not one specific development process that should be implemented and used in all new PSS development initiatives. Instead managers need to select a process that fit the services and business model of the PSS under development.

Limitations and further research

The fact that we identified few examples of firms offering services through result-oriented business models is an important limitation with this study, and more cases and examples are needed to reach saturation. Further research, thus, should continue to explore the characteristics of new PSS development also in other cases and other types of organizations to verify our findings.

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