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DEVELOPING A PRODUCT-SERVICE SYSTEM BUSINESS MODEL: THE ROLE OF INNOVATION

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Tässä työssä tutkittiin innovaatioiden roolia tuote-palvelujärjestelmien kehityksessä. Tuote-palvelujärjestelmät ovat liiketoimintamalleja, joissa tuotteita ja palveluita yhdistetään yhdeksi tarjoomaksi, jolla pyritään vastaamaan tehokkaammin asiakkaan tarpeisiin. Työn tavoitteena oli muodostaa kuva siitä, mitkä tekijät vaikuttavat tuote-palvelujärjestelmien menestykseen ja suorituskykyyn, ja minkälainen innovointi vaikuttaa näiden tekijöiden kehitykseen. Tuote-palvelujärjestelmien menestystekijöitä sekä niihin liittyviä innovointikeinoja tutkittiin ensin kirjallisuuskatsauksessa. Kirjallisuudesta tuotiin esiin tärkeimmät menestystekijät sekä innovointikeinot tuote-palvelujärjestelmien kehityksessä. Työn empiirisessä osuudessa toteutettiin intensiivinen tapaustutkimus, jossa tutkittiin pk-yrityksen tuote-palvelujärjestelmän syntymistä ja kehitystä. Empiirinen aineisto koostui yrityksen toimitusjohtajan haastattelusta sekä yrityksen toimittamasta lisämateriaalista. Lopputuloksena rakentui matriisi, josta ilmenee tuote-palvelujärjestelmien tärkeimmät menestystekijät sekä niihin vaikuttavat innovointikeinot. Lopputuloksissa korostui tuote-palvelujärjestelmien kehityksen ja menestyksen osalta prosessi-innovaatiot sekä avoin innovointi. Työn lopputulos antaa suuntaa toimivan tuote-palvelujärjestelmän kehittämiseksi ja tuo esiin seikkoja, jotka ovat olennaisia tuote-palvelujärjestelmien toimivuudelle.

ABSTRACT

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The aim of this study was to explore the role of innovation in the implementation and development of a Product-Service System business model. Product-Service Systems (PSS) are business models that integrate products and services into an offering that is capable of fulfilling specific client needs by delivering a required functionality. The aim of this study was to first examine the success factors of PSS business models, and then the innovation methods relevant to developing those success factors. The PSS success factors and innovation were first studied through a literature review. When the success factors and innovation methods were identified from existing literature, an intensive case study was conducted to examine a special case of PSS development in one industry. The empirical data consisted of an interview with the company CEO and additional material provided by the company. As a result, a matrix was formed to illustrate the main success factors and the innovation methods relevant to them. The final results highlight the role of process innovation and open innovation in the development and success of PSS business models. Overall this study gives direction for managers wanting to develop their organization into a successful PSS business.

TABLE OF CONTENTS

1. INTRODUCTION	6
1.1 Scope and Limitations	8
1.2 Research Questions	9
1.3 Outline of the Study	9
1.4 Research Framework	10
2. PRODUCT-SERVICE SYSTEMS	11
2.1 Definition	11
2.2 Evolution	12
2.3 Three Types of PSS	13
2.4 PSS Performance.....	13
2.4.1 Studies of PSS Performance	14
2.5 The Critical Factors of PSS Success.....	16
3. METHODS OF INNOVATION.....	16
3.1 Modes of Innovation	17
3.1.1 Service Product Innovation.....	18
3.1.2 Process Innovation	20
3.1.3 Business Model Innovation.....	21
3.1.4 Open Innovation	24
3.2 The Contribution of Innovation	26
4. CASE FLEXIM SECURITY	26
4.1 Development of the Business Model	26
4.2 Innovating the Product	27
4.3 Constant Improvement of Processes	29
4.4 The Role of External Resources	30
4.5 Flexim Security as a Successful PSS Business	30
5. CONCLUSIONS	31
6.1 The Main Results of the Study	32
6.2 Limitations of the Study and Suggestions for Future Research.....	35
REFERENCES	36

LIST OF FIGURES

Figure 1. Strategies to drive revenue and profitability in 2015 (PTC 2013)

Figure 2. Manufacturers using services as a key way to differentiate their products (PTC 2013)

Figure 3. Theoretical framework of the study

Figure 4. Summary of the study

1. INTRODUCTION

As the global competition environment and customer demands have evolved during the past few decades, businesses with traditional product- and service offerings have met new challenges to meet the increasingly complex demands of customers. Manufacturing firms have shifted from mass production to mass customization and personalization to acknowledge the manifold demands of customers (Salvador, Rungtusanatham & Montanez 2015). While customization and technological innovation have been successfully utilized for competition among manufacturing firms, a more holistic approach to satisfy customer demands have emerged in the business field. The focus has shifted from the product itself to the final needs of customers. This approach has led to the realization of Product Service Systems (PSS).

It has been globally recognized that manufacturers serving developed economies are moving away from concentrating their efforts on products and production to service-driven business models. Successful development and delivery of advanced services offer significant commercial benefits to manufacturers, such as commercial resilience through increased customer intimacy, opportunities for sustained growth and reduced financial risk (Baines 2015). A study by Oxford Economics (PTC 2013) shows a distinct trend that manufacturers are shifting their strategies towards more service-driven PSS business models. The top 3 emerging strategies reported by manufacturing executives were *Voice of the customer initiatives*, *Performance-based service contracts* and *Ability to design, build and service anywhere*. Moreover, the study shows that almost two thirds of manufacturers are enhancing their services as a key way to differentiate their products, and by 2015 the amount is expected to increase to 71%. The numbers are shown in figure 1 and 2.

Manufacturers tend to place more emphasis on adding value to customers through PSS innovation due to competition and environment regulations (Song et. al. 2015). With a PSS approach, product and service are considered together as one offering to create added value to the final customer. As Slywotzky and Wise (2003) noted, PSS can be considered another type of demand innovation; it considers the supplementary demand that is added to the primary demand of products and services. This approach offers an opportunity to improve the value creation process of a company by focusing on final customer needs and

developing product-service solutions to fulfil those specific needs. For most organizations however, the process of adapting such business model requires significant changes within the organization's internal processes and external stakeholder network. Innovation at several levels is required to carry out the transformation towards a PSS business model.

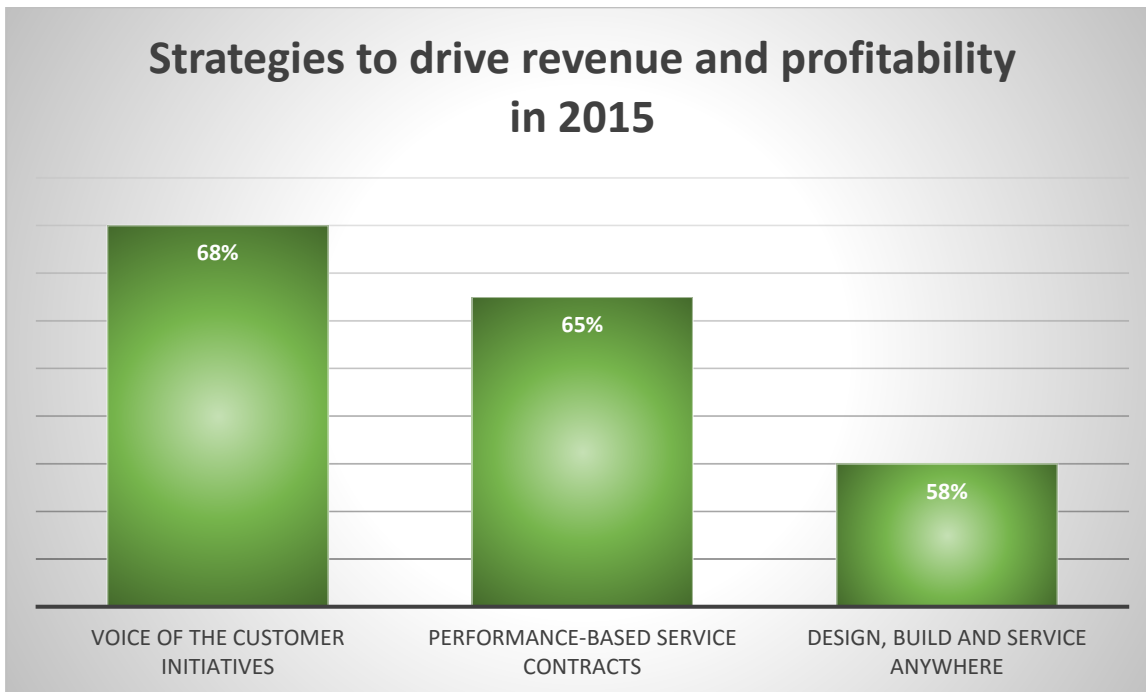


Figure 1. Strategies to drive revenue and profitability in 2015 (PTC 2013)

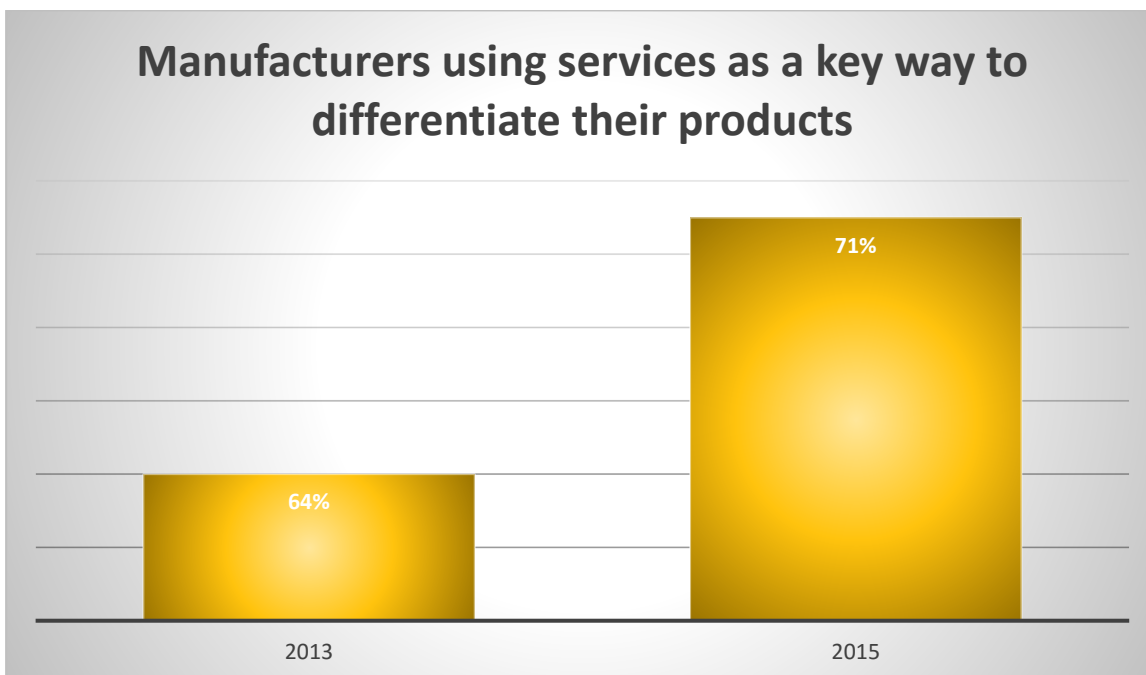


Figure 2. Manufacturers using services as a key way to differentiate their products (PTC 2013)

1.1 Scope and Limitations

Past studies have researched the field of PSS widely from the manufacturing firms' perspective. In reference to Mont (2003), it has become an important trend in the manufacturing industry to use service as a way to gain competitive advantage through improved life cycle efficiency and more comprehensive offering. Different methodologies and frameworks for PSS development, adaptation and design processes, as well as their advantages, have been researched in past studies (Wang et al. 2011; Muto et al. 2015). Wallin et al. (2014) studied how PSS innovation capabilities are developed in companies at the micro-foundation level. Hong et al. (2015) studied the roles of product and process technological innovation to PSS success. While these studies contribute to the innovation research in the PSS context, a more holistic view of required innovation practices for successful PSS implementation is lacking research. The significance of different innovation modes have been studied in the service context (Wang et al. 2015), but this approach has not yet been adapted in the PSS literature.

The scope of this study is to outline the innovation processes that are pertinent for the PSS business model development. The focus is on the processes and practices behind innovation that are considered relevant for designing and adapting a successful PSS business model in a company. The scope is to elucidate the design process from managerial perspective to give guidance for managers seeking to develop their organization towards a PSS-driven business. The aim is also to give academics information on the relevant innovation processes behind developing a PSS business model.

Existing literature and theories of PSS success and innovation are examined to form a basis for the empirical section of this study. Due to the limitation of time and resources, this study is limited to exploring the main characteristics of successful PSS models and innovation practices. This study includes discussion of the significant factors that affect the formation of a successful PSS business model. The factors are discussed from two perspectives: *PSS performance* and *innovation practices*. The empirical section of this study is limited to exploring an intensive single-case study of a medium-sized company.

1.2 Research Questions

The aim of this study is to explore how innovation methods and –practices can affect the implementation of a successful PSS business model. Therefore, the main research question is formulated as follows:

What is the role of innovation in the development of a successful PSS business model?

To answer this question, the main question is divided into three sub-questions. First, the factors behind successful PSS business models are examined. Then, the innovation processes and methods that can be utilised to develop the success factors of a PSS business model are examined. Thus, the first two sub-questions were formulated as follows:

Q1: What are the relevant factors that form a successful PSS?

Q2: What innovation processes and methods are relevant for developing a PSS business model?

Finally, once these questions are answered, the relations between the success factors and the innovation processes and methods are examined.

Q3: How the contribution of innovation to the development of a successful PSS can be established?

To answer these questions, we first relate to previous studies and conduct a single-case study to validate our findings.

1.3 Outline of the Study

The outline of this study comprises of six chapters. Chapter 1 presents the introduction, background and research framework for this study. In chapter 2, the existing literature of PSS success factors is discussed. In chapter 3, innovation methods and processes are discussed with the focus on PSS development. In chapter 4, an intensive single-case study is conducted to collect data and to understand the concept within its real-life context. The aim of conducting an intensive case study is not to produce generalizations, but to learn how a specific and unique case works, and to understand how the chosen case works as a

configurative and ideographic unit of analysis (Eriksson and Kovalainen 2008). A special case of PSS in one industry was chosen. Finally, in chapter 5, conclusions are drawn from the study and the research questions are answered.

1.4 Research Framework

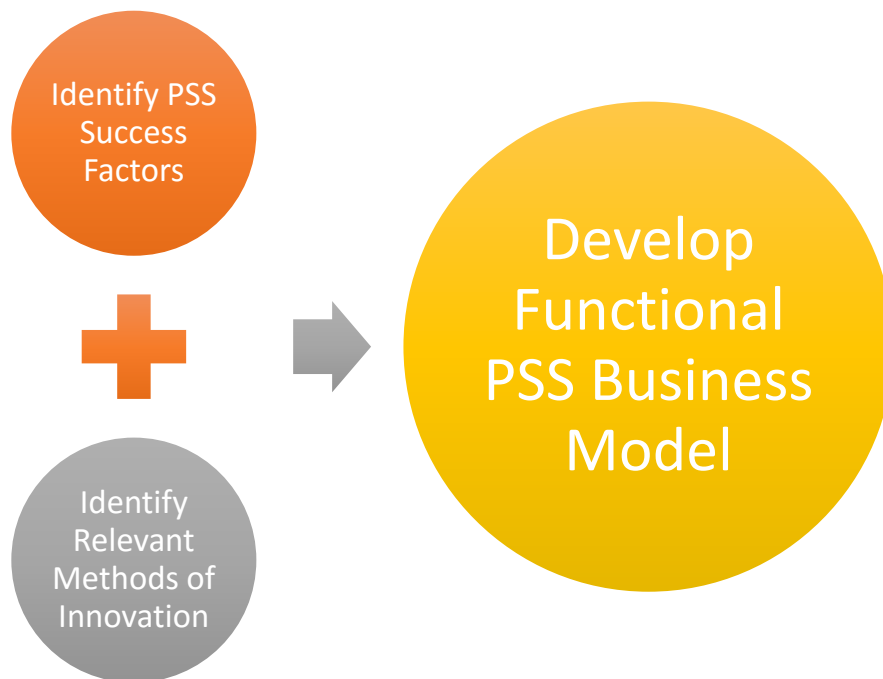


Figure 3. Theoretical framework of the study.

In this study, PSS success factors are first examined. After identifying the relevant success factors, innovation methods that affect the formation of the identified factors are examined. The aim of this approach is to establish a paradigm of how innovation can be pursued in the process of PSS business model development.

2. PRODUCT-SERVICE SYSTEMS

As the global competition has brought pressure on the developed countries' manufacturing industry, it has been recognized that manufacturers are moving away from concentrating their efforts on products and production and toward a services focus (Baines 2015). The innovation efforts of manufacturing companies, such as Xerox and Rolls Royce, has resulted in new ways to conduct business where products are combined with services to form solutions to meet final customer needs.

2.1 Definition

In previous studies and literature, the concept of PSS has been defined in multiple ways by various authors. It was first defined by Goedkoop et al. (1999) as a combination of products and services in a system that provides functionality for consumers and reduces environmental impact. The early stages of PSS research have emphasized the environmental benefits of adapting PSS business models. Manzini and Vezzoli (2003) define PSS as a strategic design for sustainability, aiming at an integrated system of products, services and communication. Mont (2003) described PSS as process of providing satisfaction and function to the customer through systems that integrate products and services to reduce environmental impact during their life cycle. Another prevailing factor in the existing definitions has been the focus on providing solutions for the final customer demands and functionality (Mont 2003; Brandstötter et al. 2003; Wong 2004).

Baines et al. (2007) compiled the existing definitions of PSS and summarized the following: A PSS is an integrated product and service offering that delivers value in use, which offers the opportunity to decouple economic success from material consumption and hence reduce the environmental impact of economic activity. For manufacturing companies this traditionally means a shift from offering original products to offering the availability of a product, a specific function or a result to the final consumer. It is evident that for most manufacturing companies wanting to adopt a PSS business model, a transformation is required at the strategic and organizational levels, as the service element has to be efficiently introduced to the final offering (Manzini & Vezzoli 2003; Baines 2015).

In this study, a definition of PSS is used which links definitions by Goedkoop et al. (1999), Manzini and Vezzoli (2003), Wong (2004) and Baines et al. (2007):

Innovation strategy to design an integrated product and service offering in a stakeholder network which is capable of fulfilling specific client needs by delivering a required functionality.

This definition is suitable for this study as we are interested in the innovation processes behind developing a functional PSS business model.

2.2 Evolution

As the global market has brought pressure on the manufacturing industry of developed countries, the inability to compete with price has forced companies to rethink their competitive strategy. As a result, traditional manufacturing companies have shifted from product-oriented values to service-oriented values (Wang et al. 2011). Several companies have undergone this process through servitization. The process of servitization is described by Bustinza et al. (2015) as a business model change and organizational transformation from selling goods to selling an integrated combination of goods and services. Although servitization and PSS are often discussed in tandem, they are not exactly the same thing. As Baines et al. (2007) describe, a PSS is a special case in servitization, which values asset performance or utilization rather than ownership.

The research field of PSS began to form in the 1990s as the environmental issues of mass-manufacturing were brought to discussion. This together with the increasing interest towards functional business models, it was soon realized that companies could improve their position in the value chain and reduce their environmental impact by focusing on the final consumer needs and delivering integrated solutions to fulfil them (Tukker & Tischner 2006). As of today, the research has spread to PSS performance measurement (Hong et al. 2015; Durugbo 2013), implementation methods (Clayton et al. 2012; Kindström 2010; Martinez et al. 2010; Xing et al. 2013) and overall has taken a more holistic approach towards defining the business model and the concepts it encompasses.

2.3 Three Types of PSS

There are many applications for PSSs as different products and services can be brought together in numerous ways to form unique systems and offerings that are difficult to imitate. Tukker (2004) studied the various types of known PSSs and resulted in three main categories:

Product-oriented PSS: The product is sold in a traditional manner and supporting services are included (e.g. installation, maintenance and repair).

Use-oriented PSS: Providing the use or availability of a product to the customer without transferring the ownership (i.e. leasing).

Result-oriented PSS: Selling a desired result or capability instead of a product (i.e. cleaning services).

What the presented models have in common is that they provide customers with a complete solution, utility or function consisting of both physical products and non-physical services (Aurich et al. 2010; Baines et al. 2007). In terms of adapting a PSS business model, the process of successfully implementing the required organizational changes remains a complex process. As Reim et al. (2015) remark, most companies lack the internal ability to design and implement PSS business models successfully. They also highlight that different operational-level tactics are required depending on the desired PSS model and the organization's internal and external conditions; basic guidelines for PSS implementation can be established, but ultimately the tactic-level decisions must be analysed case by case. It is evident that the successful implementation of a PSS model is largely dependent on the organization's internal ability to address the desired outcome and carry out the required organizational transformation efficiently.

2.4 PSS Performance

In the context of this study, we are interested in the factors that result in a well-performing PSS business model. It is therefore important to define the critical factors affecting the performance of a PSS. We relate to previous studies to highlight the most influential factors discovered in terms of PSS performance.

2.4.1 Studies of PSS Performance

Pan and Nguyen (2015) studied the effectiveness of a sustainable Product-Service System by adapting the Balanced Scorecard as an evaluation tool. They discovered that internal processes have the most influential effect on PSS performance, followed by customer perspectives. Further, they discovered that product/service innovation is seen as the most important area of improvement to achieve PSS success. These findings indicate that the innovation process and development of internal processes should be emphasized, which refers to the organizational transformation required for a successful PSS implementation. The internal processes must be constructed to support the shift from manufacturing to providing functional product-service offerings in a financially viable manner.

Hong et al. (2015) conducted a survey-based research, including 221 companies, to study the effects of PSS on firm performance. From the results, they highlighted that PSS affects firm performance indirectly by promoting technological innovation of processes. To achieve their managerial goals, modern PSS businesses should emphasize process-oriented technological innovations, rather than product-oriented ones, as it provides customers with new approaches and leads to enhanced internal value creation process. It is apparent that companies should develop their internal processes through process innovation to support the required organizational transformation.

Laperche and Picard (2013) also discovered in their multiple-case study that the development of PSS is often accompanied by several organizational and managerial changes in the area of innovation. They also noted the importance of changes in the organization's internal structure. However, they also highlight the importance of external innovation, networks and new partnerships, as PSS increases the need of broadening the outward vision. External resources are needed for open innovation as a firm cannot innovate alone. Early customer involvement and stakeholder collaboration can provide companies with increased creative resources and more competitive solutions. Morelli (2006) further emphasized the importance of partnerships at the PSS design phase, as the innovation process of PSS is directly or indirectly influenced by all actors participating to them; severe limitations of the development of PSS emerge when its socio-technological horizon is beyond the characteristics of the developers.

Manzini and Vezzoli (2003) studied the strategic design approaches to develop sustainable PSSs. They noted that the adoption of PSS business model implies new types of stakeholder relationships and/or partnerships, resulting in a systemic resources optimization. In contrast to Hong et al. (2015), Manzini and Vezzoli note that the efficiency of innovation does not lie in the area of technology itself, but in the way the existing technologies can be systemized in the stakeholder/value creation network to develop an integrated system of products, services and communication. They use the expression *strategic design for sustainability*, which stands for the capability to create new stakeholder configurations and develop an integrated system of products, services and communication that is coherent with the medium-long term perspective of sustainability, while simultaneously being economically feasible. They further highlight stakeholder reconfiguration as the main innovation for achieving the convergence of economic interests and systemic resource optimization and within the stakeholder network.

Baines et al. (2007) studied in their literature review the features in the effective design of a PSS. They highlighted the importance of client's perspective in the design, making and delivery process of a PSS. The changes in organizational structure, together with customer and stakeholder involvement in the process of PSS solution design are pivotal for designing efficient PSS business models. The PSS should be designed at the systemic level from the client perspective with early customer involvement and organizational restructuring.

Schweitzer and Aurich (2010) noted the necessity of continuous improvement of processes in the context of PSS. They introduce the concept of extended value creation network, which comprises of all partners necessary for both the production of the physical product and the delivery of the service components of the PSS. The continuous improvement process describes a feedback loop, where solutions are developed in a formalized problem solving process in order to eliminate identified weaknesses, which are then realized by the affected organizational units in the extended value creation network. The design of information exchange processes between customers and stakeholders represent a crucial point for PSS improvement and performance.

2.5 The Critical Factors of PSS Success

This leaves us to conclude that the critical factors of PSS performance and success incorporate changes in both internal and external processes. From internal perspective, one outstanding factor is the innovation of internal processes. The successful adaptation of a PSS business model necessitates companies to rethink their organizational structure to correspond with the complex PSS value creation system. A company's capability to innovate and systemize internal processes determines the success of adapting the PSS business model and ultimately the level of performance. External resources also play a crucial role in PSS performance; reconfiguration of involved stakeholders in the value creation network is also needed to optimize systemic resources and to reconcile economic interests. Both customer and stakeholder involvement in the process of PSS realization are required. Exchange of information in the value creation network enables a process of continuous improvement to achieve enhanced performance. The innovation and design of a PSS is not a static process, but instead a continuous process of improvement towards better performance.

3. METHODS OF INNOVATION

Manufacturing companies have increasingly started to offer services, rethinking their offerings by replacing one-time product sales with value creating relationships through service innovation (Baines 2015). As manufacturing companies have started to realize the value of integrating service elements in their product offerings, a need for developing more advanced organizational capabilities has emerged. Moreover, as a PSS typically consists of more than just an augmented product, the scope of development encompasses supporting infrastructure and organizational transformation. Thus, the process towards implementing a successful PSS design requires a comprehensive mind-set to innovation. In this chapter we investigate the role of innovation to service- and PSS development through existing innovation literature and theories.

3.1 Modes of Innovation

In manufacturing firms, the focus of innovation has traditionally been in the development and improvement of products as physical products have been the core of their business. Product- and service innovation have been seen as separate entities and thus managed separately. However, as manufacturing companies have started to include service elements in their offerings, the need to integrate product- and service innovation has been realized. One concept that has emerged from this development is service product innovation; Boone (2000) describes service product innovation as the development of a new service, which can be either a new market offering or a service that is new to the firm of the industry. This approach to innovation is still close to the traditional view which only focuses on developing individual marketable offerings with primarily customer driven market focus.

However, innovation does not occur only at the level of new marketable offerings, but also at the process level. Process innovation is defined as new elements introduced into an organization's production or service operations, such as new technologies, equipment, systems, material inputs, work, and information flows employed to produce a product or a service, where the focus is on internal activities and efficiency improvement (Utterback and Abernathy 1975). It is fundamental to an organization's ability to change the way it works and to maintain its competitive edge in a dynamic market environment (Bender et al. 2000). This type of innovation is very different from product/service innovation as it aims to reshape organizational structures, such as established practices, teams and information flow.

More recently, a third innovation paradigm has emerged to complement the previously examined innovation modes. Research of business model innovation has followed the revolutionary transformation of manufacturing organizations towards more complex value creation processes that include elements from both product/service innovation and process innovation. Voss and Zomerdijs (2007) defined business model innovation as a substantial or complete change in the way revenues and profits are earned, which is often accompanied by innovations in organizational structures in order to accommodate the changes in the business model. They further noted that in service innovation, product and process innovation are linked in an iterative process and are then linked to business model innovation; successful product innovations are often preceded by process innovation, and

business model innovation frequently goes hand in hand with product and process innovation.

For the purpose of this study, innovation is observed from four perspectives that are considered relevant for the PSS development process. First, service product innovation involves the introduction of new services to the market. Second, process innovation refers to the modification of operational-level activities, such as production and delivery methods and resource utilization. Third, business model innovation refers to extensive changes in the value creation process. Finally, open innovation is discussed which refers to the utilization of external resources in the innovation process.

3.1.1 Service Product Innovation

The concept of PSS implies the integration of both products and services. Companies are actively seeking to deliver increasingly advanced services that integrate services and products more closely (Bustinza et al. 2015). This integration process has been studied widely through the concept of servitization and has resulted in the observation that service innovations are often accompanied by process innovations due to the characteristics of services, which are produced and delivered simultaneously (Wang et al. 2015). The service product level of innovation is briefly discussed independently in this section, as the concept of PSS emphasizes the process- and business level innovations.

Oke (2007) studied the types of innovation predominant in the service sector, together with innovation performance and innovation management practices. He divided innovations into two categories: incremental innovations (improvements to existing products and services) and radical innovations (new products and services). The results of his study show that the pursuit of radical product and service innovations is positively associated with innovation performance. A positive relation was also detected between incremental innovations and innovation performance. Further, five innovation management practices (*innovation strategy, human resource management, creativity and ideas management, selection and portfolio management and implementation*) were examined in terms of their relation to the pursuit of innovativeness. A notable finding was that the five practices explained a significant amount of variation in both radical product- and radical service innovation, but considerably less in incremental innovation. Having a comprehensible and working *innovation strategy*

was found to be most significantly related to both radical product- and service innovations, followed by *human resource management* and *creativity and ideas management*. However, companies were observed to focus innovation activities more on incremental innovations. This suggests that while radical innovations are often seen as more valuable due to their appeal to the market, incremental innovations should be considered in more detail in companies' innovation strategies as they occur more frequently.

While the management practices were observed significant only to radical innovations, the success factors for both radical and incremental innovations can be similar. As Droege et al. (2009) noted, basically the same antecedents are required for both radical and incremental innovations but often in different degrees of presence and intensity. Therefore the focus of innovation management should encompass the same practices, such as presented by Oke (2007) or de Brentani (2001), regardless of the degree of innovation pursued.

The design process of a PSS offering is notably different from the traditional product development process. Szejczewski et al. (2015) studied the PSS offering development process through new product development (NPD) approach. Their cross-case study of PSS companies shows that the after-sales services have a significant role in the NPD process. Most notably the after-sales was shown to reduce cost-of-ownership, prevent downtime, ensure customer satisfaction and generate significant revenues, often at higher margins than product sales. Companies used cross-functional teams for NPD to take into account the after-sales requirements (i.e. customer support) in early stages of development. Field service data was used for setting service-related design goals in the design stage of NPD. This approach to designing new products is suitable for PSS businesses as it takes into account both the customer requirements and the service elements at early stages of the design process. It helps companies to merge the tangible product elements with the intangible services into a functional product-service offering.

To conclude, companies should focus on developing their innovation strategy to include product/service-level decisions, as they play a significant role in the PSS development process. Innovations are not always radical, in fact, they are more often incremental improvements of existing products and processes. Thus, managers should consider the incremental innovation processes in their innovation strategy. When developing new PSS

offerings, the after-sales services should be emphasized at early development stages, as they potentially form the major component of a PSS offering.

3.1.2 Process Innovation

The servitization of manufacturing firms has been observed as a prominent way of improving business competitiveness (Bustinza et al. 2015). As manufacturers have shifted from focusing on product innovation and development to considering final customer needs, the significance of services supporting the product and final value proposition has been recognized. However, the concept of servitization compasses more than simply developing new service offerings. As Baines (2015) remarks, in addition to developing new service offerings, the process of servitization implies the adoption of new technology and a widespread organizational transformation. This includes factors such as change in organizational culture, development of new skills, knowledge and partnerships (Lapreche & Picard 2013). Manufacturers have realized the need to transform their business to prepare for future market demands, as a study by Oxford Economics in 2013 shows that out of 300 manufacturing executives 68% agree or strongly agree that their firm will be undergoing significant business process transformations in the next 3 years (PTC 2013).

As mentioned in chapter 2, a PSS usually features a change in the way a product-service solution is delivered to the customer, such as leasing or delivering a result instead of a physical product. The shift in the delivery method implies a need for process innovation. Wang et al. (2015) studied the modes of innovation used in 69 service innovation projects. They discovered that service process innovations accounted for more than a half of the projects studied (52,6%), followed by business model innovations (26,1%) and service product innovations (20.3%). They argue that the dominance of service process innovation derives from the nature of services; as service production and consumption are simultaneous, service product innovations are in fact sometimes primarily service process innovations and they often occur jointly. As the service element is essential in PSS business models, the process innovation element evidently has a significant role in the PSS development process.

Hong et. al. (2015) studied the effects of technological innovation on firm performance in PSS context. They further divide technological innovation into two areas – process and product innovation. In their study, Hong et. al. (2015) found that specifically process

technological innovation can lead to higher firm performance instead of product technological innovation. Further, they discovered that implementing a PSS business model affects firm performance indirectly by promoting technological innovation. This observation is linked to the phenomenon of service paradox (Gebauer et. al. 2005); simply introducing new service offerings does not directly lead to improved returns, but instead through the development of improved processes that support the servitized business model. These findings further emphasize the importance of process innovation for PSS development and also demonstrate that product innovations alone will not likely result in a functional PSS, as the implementation of a PSS business model requires a more widespread transformation in the organization.

Gann and Salter (2000) studied the innovation drivers for product-based and service-enhanced firms. They noted the emergence of new forms of production in the construction industry that centre on the delivery of both products and services, such as providing system integration services and supporting value-added services. Among the studied organizations, this approach resulted in the need for internal business process development and new relationships with stakeholders. They conclude that service-enhanced forms of production require a change in the R&D policies to shift from production of physical technologies to encompass organizational issues and information flow concerning the new production- and delivery methods. Information flow can enhance internal learning processes by using procedures such as job rotation and regular meetings between cross-sectional teams.

The process level of innovation evidently plays a significant role in the PSS transformation process. As the PSS business model necessitates changes in the way products and services are offered, companies must adapt their processes to support the value creation mechanisms of the PSS. This includes the development of stakeholder relationships, information flow and customer involvement.

3.1.3 Business Model Innovation

As mentioned by Baines (2015), manufacturing companies shifting to a PSS driven business model require an organizational transformation in order to obtain the potential benefits of servitization. To demonstrate how to efficiently and effectively transform a manufacturing organization to exploit this opportunity remains a challenge in the field of service innovation

research. One of the major problems manufacturing companies face is the phenomenon of service paradox; extending the service business leads to increased service offerings and higher costs, but not to correspondingly higher returns (Gebauer et al. 2005). They concluded that to overcome this problem, manufacturing companies require various changes in their organizational structure. This indicates that manufacturing companies should emphasize the organizational innovation towards new processes and practices to support the service applications. Moreover, the widespread organizational transformation mentioned here indicates a need for business model innovation, as it encompasses changes in the value creation system and stakeholder network. Business models are described by Aurich et al. (2010) as simplified descriptions of the mechanisms companies use to create value, consisting of three main components:

Value proposition: Defines the benefit the customer or stakeholder of the company achieve within the cooperation.

Architecture of value creation: Defines the benefit the company provides and how it provides it, including interaction with internal and external units.

Benefit model: Defines the mix of benefit sources and kinds of benefit.

Adapting a PSS business model thereby requires a fundamental shift in the way an organization functions, including internal processes and external stakeholder relationships. The scope of innovation has to be broadened to accommodate the required changes in the business logic. For this purpose, business model innovation offers a suitable approach to implement the transformation through re-conceptualising the purpose of the firm and the value creation logic (Bocken et al. 2014). The adapted PSS business model determines the extent of innovation required. For product- and use-oriented PSS business models, the changes are mainly associated with product maintenance, remanufacturing, improved durability and availability, as these models emphasize the intensive use of the product. More radical innovations, including e.g. stakeholder realignment and new service design, have the potential to significantly improve PSS performance especially among result-oriented business models by providing added value to customers and improved sustainability (Reim et al. 2015).

The main characteristic of a PSS and servitization is the shift from offering traditional products to offer customers with a desired functionality or result. For manufacturing firms, this transformation requires changes at the business model level, including value creation

logic and architecture. Velamuri et al. (2013) studied the effects of PSS as a driver for business model innovation; they identified five distinct services that manufacturing companies are providing in conjunction with their traditional product to innovate their business model. First, *business consulting* was used to increase customer's awareness of the product and to help customers understand their needs better. A customized solution could then be designed to meet customer demands better. The firms were also more involved with the customer activities, leading to new value chain architectures. Second, firms provided *comprehensive services* where the asset ownership and risks are held by the manufacturer instead of the customer. This led to new value chain architectures, where firms were looking to capture stable revenue streams through asset uptime service contracts instead of one-time sales transactions. Third, firms provided *educational services* and training courses for customers, based on hands-on experience backed up through expert tuition. This led to additional revenue streams and additional value to customers through i.e. maintenance training, resulting in improved machine uptimes and new value chain architectures. Fourth, cooperation with 3rd party financial institutions was used to offer *financial services*, improving the value proposition they offered to customers, and to encourage customers to buy the products. Finally, *information management services* were used to monitor assets, customer behaviour and supplier commitment to establish new value chain architectures and customer service processes.

The adaptation of a PSS business model evidently necessitates innovation beyond the product and process levels, as it demands for a comprehensive rethink of value proposition, value chain architecture and cost structures. While process-level innovations are necessary towards a functional PSS, tapping into the major benefits of PSS require more comprehensive changes regarding the value proposition and value chain architecture. Developing service offerings alone is simple enough, but aligning the service with the product, along with managing stakeholder cooperation, internal and external resource alignment and value creation architecture are essential for avoiding the service paradox and realizing the product-service solution in a financially viable way. Moreover, it is generally accepted that a better business model can often beat a better technology (Chesbrough 2011).

3.1.4 Open Innovation

In addition to companies' internal R&D, organizations today can take advantage of existing innovations to propel their technologies. Innovation can therefore be perceived as an exchangeable entity instead of an internal asset, which can be altered through service networks and customised to generate business value (Carroll and Helfert 2015). The concept of *open innovation* was first devised by Chesbrough (2003) as "a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology". The open innovation model suggests that companies should move from the closed innovation model, where projects are launched from the internal science and technology base of the company and exit to the market, to the open innovation model, where projects can be launched from either internal or external technology sources, and new technology can enter into the process at various development stages (Chesbrough 2012).

This concept is valuable for all companies wanting to expand their innovation capabilities, especially in the PSS context when a company has less experience from the service environment. The resources of a single organization are always limited, which creates boundaries to the extent of innovation that can be performed internally. Opening the innovation process to external partners allows companies to utilize more resources and establish new practices, such as user co-creation, R&D alliances and joint ventures. Such practices and openness are not inherent in most organizations' business models, which concurrently raises the importance of business model innovation. Open innovation and business model innovation function in tandem; as Chesbrough (2012) notes, open innovation processes combine internal and external ideas together into platforms, architectures and systems, and those processes utilize business models to define the requirements for these architectures and systems.

Chesbrough (2012) defines two important kinds of open innovation:

Outside-in/inbound open innovation: opening the company's innovation process to external inputs and contributions.

Inside-out/outbound open innovation: allowing unused and underutilized ideas to go outside the organization for others to use in their businesses and business models.

Chesbrough and Brunswicker (2014) discovered in their survey-based study that 78 percent of the 125 companies surveyed reported practicing open innovation with increasing management support. They further studied the leading open innovation practices used, and found that inbound open innovation practices are far more commonly used than outbound practices. Co-creation with customers and consumers was rated most important among inbound practices, followed by informal networking and university research grants. Joint venture activities were considered the most important outbound open innovation practice. This offers a promising approach to achieve both the customer involvement and cooperation, together with stakeholder interaction, that have been noticed important for the development of a PSS business model. Opening the innovation process enables organizations to obtain new ideas from customers and consumers, and utilize supplementary resources from external inputs in their innovation process to establish new value creation architectures.

Considering the adaptation of both open innovation model and a PSS, they bring major challenges to organizations as the changes reach beyond the product-level design to processes and value creation architectures. Martinez et al. (2009) discovered that manufacturing companies shifting to product-service providers faced principal problems in five categories: embedded product-service culture, delivery of integrated offering, internal processes and capabilities, strategic alignment and supplier relationships. Overcoming these problems require integrated activities between internal functions, the organization and the customer and suppliers. This view is expanded by the open innovation and business model innovation approaches, where the required changes expand to the value creation architecture and –systems. Chesbrough and Brunswicker (2014) discovered that companies starting their open innovation programs faced significant challenges in managing organizational change and external relationships. Focusing on service innovation, making customers central of the process, and opening up to other companies require substantial amount of internal change, and ultimately changes to the business model (Chesbrough 2011). Managing the organizational changes at various levels of the company is a difficult process and remains a challenge for most companies.

3.2 The Contribution of Innovation

In this section, four main modes of innovation were discussed. A notable observation was made regarding the service product innovation and process innovation. As PSS value creation relies strongly on services, process innovations have become increasingly important as service innovations are in fact often process innovations due to their intangibility and the resulting production and delivery processes of services. The value creation architecture must be constructed to support the value capture processes of PSS solutions. Opening the innovation process to external inputs enables companies to make use of new expert knowledge through e.g. R&D alliances, joint ventures and co-creation.

4. CASE FLEXIM SECURITY

To test the observations made from previous studies and literature, an intensive single-case study is conducted. The case company was chosen on the basis of its innovation-driven strategy and highly servitized business model. Flexim Security Oy is a Finnish medium-size technology company operating in the security industry. It is a growth company that wants to challenge the security industry by developing its advanced services. Today Flexim provides customers with advanced service solutions e.g. in security technology and access control. The company has a history of transforming small traditional locking firms into an advanced solution provider that it is today. It was hereby a fitting case for the purpose of studying the PSS implementation and the related innovation processes. The data was gathered from a 1 hour interview with the CEO and from additional information material provided by the CEO.

4.1 Development of the Business Model

The company started as a traditional product-oriented locking firm with no stakeholder contacts. In 2005 the company reviewed their strategy and began developing a security technology company with means to internationalize. This resulted in major changes in the value creation architecture and organizational structure. First, they realized that door

installations occupy 3-5 different operators that are often responsible for only one aspect of the door. By taking responsibility of all technologies inside the door they could achieve better cost-efficiency and clarify the responsibilities in the installation process.

“Cost-conscious customers realized that this makes sense ... today it has become more apparent that large customers and construction companies buy overall solutions.”

Flexim saw innovation as a medium to exploit this untapped market space in the industry, create new demand and achieve highly profitable growth. Second, the company took a different mind-set to business. As the rest of the industry were searching for “*customers for products*”, Flexim turned this thinking upside-down and took a “*products for customers*” approach. This mind-set directed the focus to the final customer needs and enabled the company to develop comprehensive solutions to fulfil specific demands. They also soon realized that different customers have very diverse demands.

“We couldn’t solve them [demands] with same things ... soon our supply started to better meet our client segments’ needs both in products and services.”

Today the company’s focus is on its customers and account management. Business is based on service contracts instead of one-time product sales, which creates more stable value streams and enables the company to work more closely with its customers. Flexim offers a wide variety of bundled services that are aimed at different market segments and customer requirements. Most of the services offered can be considered after-sales services, e.g. documenting, user support, express maintenance, SaaS and Extranet. As Szwejcowski et al. (2015) noted, the after-sales services play an important role in the PSS business model. The same can be observed in the case of Flexim where majority of the services offered can be considered contract-based after-sales services.

4.2 Innovating the Product

As Flexim started as a product-oriented company, the strategic shift to develop service solutions from a customer-oriented mind-set required the company to rethink its product.

“When we shifted to a service company, it affected the whole supply. Today customers approach problems from a solution perspective, for example life-cycle deals that include products and services with a 10-year contract.”

The company sees its products and services as fixed together. The role and importance of services has been realized. Flexim emphasizes customer needs and service- and process descriptions in their service development.

“[The industry] has developed to a point where services are of great importance ... it's very important to have service- and process descriptions, as they give the meat and bone for the service. Services must be first built to meet customer demands and then packaged.”

Product- and service development are seen as equally important, although more money is spent on product development due to high costs of technology. Platform-thinking plays an important role in product- and service development.

“The company is based on the ability to build a good platform... a company platform, a technology platform and a service platform that are bound together, supported by smart people and good organizational culture.”

When asked what kind of innovation processes the company utilizes, three themes were brought up. First, constant improvement of activities and processes is done inside the company, which is called everyday innovation. These improvements emerge from the ideas of personnel and customers; designing a new latch with a 3D-printer and using orange cables to help coupling are some examples of everyday innovation done in the company. Mechanics have participated in the technology design process to streamline product installation without losing the external design. Second, 2-3 year plans of expanding to new markets or selecting new product lines are made. Third, 5-10 year plans are discussed with advisory boards and specialists about industry-changing development.

“One of our best discoveries was ... bringing the mechanical serial-key concept into the electric world. It's not about evolution but revolution what's happening in that area of industry.”

Thus, Flexim considers both incremental and radical innovations in its strategy. Previous literature noted that companies often emphasize and seek radical innovations rather than incremental innovation (Oke, 2007). The same observation can be made in the case of

Flexim; incremental innovations are done constantly by improving processes and streamlining activities, but radical innovations clearly play a major role in their strategy.

“They [radical innovations] are and have always been [in a more important role], that’s why the large companies follow us. It’s likely because of the radical innovations that we have achieved the pacemaker’s role [in the industry] and we have been followed.”

4.3 Constant Improvement of Processes

Flexim strives to improve operative processes by monitoring and evaluating them constantly. To support the improvement process, they have developed their information systems, i.e. by initiating their own ERP-development project. Process improvements are discussed internally but initiatives may also come from customers.

“Both the organization and customers think we can do things better... a good example is improving productivity. Production consists of waiting, movement and the production itself. In these areas we have done streamlining.”

The process improvements and streamlining have also affected the organization structure. The CEO highlights one major challenge being the organization’s transformation from product-oriented to customer-oriented. The transformation required replacing all managers in the company.

“...this [organization structure] has been altered constantly. The organization’s structure has been reflected to our strategy, constantly sought better ways to perform. From the original line-up I have replaced all managers.”

It is evident that the implementation of the service-driven PSS business model has required major changes in the organizational structures. When it comes to extensive changes in the value creation architecture, it is sometimes necessary to change managers to achieve the desired changes.

4.4 The Role of External Resources

Flexim uses external resources quite extensively, not only in their product development but also to support their strategic thinking and future planning. They utilize a wide network of resources, including research institutes, universities, professors and specialists. Flexim has established its own advisory boards to boost strategic thinking and business development. Services and technologies have their own advisory boards that aim to promote outside-the-box thinking, consisting of external specialists. Advisory boards also meet together to form cross-functional teams to advance product- and service development.

“It’s also important that these boards, for example service advisors and technology advisors, meet together. That’s where our service products, current technology choices and roadmaps have formed. They utilize hands-on expertise.”

Flexim also develops its technologies in collaboration with the Fraunhofer institute, known i.e. for the development of MP3-technology. Other collaborations include projects with the Aalto Design Factory and Startup Sauna. These activities can be considered open innovation, as the company opens its innovation process to external inputs. Networking has also generated informal communication channels that are utilized:

“Our network is exceptionally wide, like these “phone-a-friend” type of contacts have emerged a lot. So yes, we utilize them [external resources], as individuals but also as groups.”

It is evident that Flexim values external knowledge and resources highly, and that these resources have had noteworthy influence on its product- and business development. Expanding their network and bringing the right people together has promoted the transformation of the formerly product-oriented company into the PSS business it is today.

4.5 Flexim Security as a Successful PSS Business

The characteristics of Flexim show many similarities with the success factors of PSS business models discussed in this study. The shift from product-oriented company to a customer-oriented service company has had significant impact on its organizational

structure, and it has been modified deliberately to correspond to the company's strategy. The realization of "products to customers" –mind-set has brought the company's attention to final customer needs, allowing them to provide customers with bundled service solutions, resulting in new value creation architectures. Networking has also played a significant role in the company's development process. The company utilizes external resources extensively to advance their technologies and services, but also to sharpen their strategic thinking. Open innovation is considered as an important method to gain competitive advantage. The way Chesbrough (2012) describes open innovation processes corresponds with Flexim's operations; open innovation processes combine internal and external ideas together into platforms, architectures and systems, and those processes utilize business models to define the requirements for these architectures and systems. Processes are constantly monitored and the company pursues to streamline its processes and activities; the process of continuous improvement is distinctly practiced to achieve improved productivity.

Radical innovations are considered a major factor in the company's strategy. Innovation processes have been improved by utilizing external resources, e.g. research collaborations and specialists, and using cross-functional teams where product technologies and services are developed concurrently. Their innovation efforts have resulted in major breakthroughs in the industry, such as the electronic serial-key concept and their own security solution system Safea. The implementation of a service contract –based business model has resulted in new value creation architectures and competitive advantage. Overall Flexim can be considered a special case in PSS in the context of its industry.

5. CONCLUSIONS

This study examined the success factors of PSS business models and the innovation processes that influence the development of a successful PSS business model. Existing literature was first discussed to find examples of successful PSS business models and the influencing factors behind them. Then, innovation methods were discussed to highlight innovation processes and practices that influence the development of a PSS business model. In empirical research, an intensive single-case study was conducted to explore the

formation of a PSS business model and the innovation processes and factors influencing the development process.

6.1 The Main Results of the Study

Overall this study gives direction for managers wanting to develop their organization into a successful PSS business. Specific PSS success factors are developed both internally and externally through four main modes of innovation: *Service Product Innovation*, *Process Innovation*, *Business Model Innovation* and *Open Innovation*. These innovation modes are linked to specific areas of PSS development. A matrix was generated to illustrate the relevant PSS success factors and the modes of innovation relative to them. The relations are illustrated in figure 4.

The PSS business model is closely dependent on identifying final customer needs, for which the product service solutions are developed. For most PSS business model types, the after-sales services play a significant role in terms of value creation and customer satisfaction. Thus, identifying the after-sales requirements should be emphasized at the product service solution design stage. Establishing connecting platforms and cross-functional teams enables improved decision-making and information flow towards new PSS solutions and processes. Customer involvement, co-creation, external development projects and R&D collaborations are substantial ways to further enhance decision-making and improve technologies through the use of external expertise.

Literature emphasized the transformation process as a key success factor in PSS development process. The transformation incorporates changes in both internal and external processes. Organizational structure must be shaped to correspond with the PSS strategy and value creation system. A company's capability to modify its internal processes influences the success of adapting the PSS business model and ultimately the level of performance. Processes and structures should be continuously monitored and improved to enhance productivity and to maintain competitiveness. Process innovation also plays another crucial role in PSS development, as service innovations are often also process innovations due to the nature of services; as services are produced and consumed simultaneously, service product innovations are sometimes primarily service process innovations and they often occur jointly. As Hong et al. (2015) discovered, PSS firm

performance is primarily enhanced through process innovation instead of product innovation. Therefore process innovation should be emphasized in PSS development.

Exchange of information in the value creation network enables a process of continuous improvement to achieve enhanced performance. Information systems can be established to support information gathering and processing to enhance the continuous improvement process. Systemic resource optimization and networking leads to more efficient innovation processes and capabilities. As Manzini and Vezzoli (2003), noted, the efficiency of innovation lies in the way the existing technologies can be systemized in the stakeholder/value creation network.

At business model –level, establishing the value creation architecture and value proposition in obedience to company’s strategy is crucial to PSS performance. Many PSS business models offer advanced services instead of traditional products and services, where the value creation logic is distinctly different to one-time sales transactions. Managers need to align their organization to support the value creation and –capture of these business models in order to perform efficiently and competitively.

Opening the innovation process to external inputs can bring major benefits to companies wanting to achieve competitive edge and overall enhance their innovation process. Internal resources are always limited, which creates boundaries to the extent of innovation that can be performed internally. Utilizing external inputs, such as specialist advisors or university development projects, can result in ground breaking innovations and sustained competitive advantage. Building extensive stakeholder networks enables companies to exchange knowledge with stakeholders, enhancing R&D and business processes by optimizing systemic resources and existing technologies.



Figure 4. Summary of the study

6.2 Limitations of the Study and Suggestions for Future Research

This study was limited to exploring the relations between innovation and PSS success factors as a phenomenon. The empirical research was limited to a single-case study of a special case in PSS in one industry. Insights from other companies from different industries would provide more depth to this area of research. This area of research requires more thorough examination of specific innovation activities and tactics that contribute to PSS success. Inclusion of more quantitative assessment for this purpose is suggested. Expanding this research approach to include other industries is also suggested.

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