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Abstract:

The discussion about business models has gained considerable attention in the last decade. Business model frameworks have been developed in literature as management methods helping companies to comprehend and analyse their current business logic and guide the deployment of new strategies. In response to calls for a deeper understanding of the application of a business model approach to product-service systems (PSS), this study develops a two-level hierarchical framework that: (i) includes a set of components with pertinent, second-order variables to take into account when undergoing the shift from products to solutions; (ii) supports industrial companies, especially SMEs, in designing their future business model and in consistently planning the actions needed to implement it. The framework was applied and refined within real-life settings. The application to KINE – a robot solutions supplier – shows how key challenges faced by servitizing firms may be thoroughly addressed through the adoption of a business model perspective

Keywords: product-service systems (PSS); servitization; business model (BM); framework; SMEs

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1. Introduction

Capital goods manufacturers pursue service-led growth in order to gain new revenue streams and generate novel competitive advantages, (Neely, 2008; Rapaccini and Visintin, 2015; Peillon, Pellegrin and Burlat, 2015). Servitization, the move towards product-service systems (PSS), or servitization (Baines et al., 2009), affects a company's business model (Windhal and Lakemond, 2010; Kindström, 2010), e.g. by shifting from selling a product to selling its usage, performance, or functions (Mont, 2002; Lightfoot, Baines and Smart, 2013). However, in a majority of cases capital goods manufacturers still generate a low turnover share through services, mainly from traditional product-related services, such as spare parts, documentation, technical assistance and maintenance (Gebauer, Fleisch and Friedli, 2005; Lay, Schroeter and Biege, 2009; Copani, 2014). Therefore servitization is a not yet mature phenomenon in capital goods sectors, and companies frequently struggle to reconfigure their business model (Evanschitzky, Wangenheim and Woisetschläger, 2011; Kindström and Kowalkowski, 2014).

From a conceptual point of view, moreover, the business model (BM) perspective in describing the move towards PSS has received little attention in the scientific literature, with very few to characterize PSS BMs in a structured way (Adrodegari and Saccani, 2017).

Finally, from a managerial standpoint, a deeper understanding of PSS business models is needed, as well as an increased knowledge on how to implement them in practice (Barquet et al., 2013; Reim, Parida and Örtqvist, 2015).

This paper addresses these gaps, and develops a two-level hierarchical BM framework that can be used to describe PSS business models and guide their development by capital goods companies. The framework is drawn on established BM components from the literature, and it provides an operationalization of each component

through detailed variables. Moreover, by applying the framework in practice, this paper discusses how it can support industrial companies, and particularly SMEs, in designing their future business model and in consistently planning and deploying the actions needed to implement it.

The paper is organized as follows. Section 2 presents a summary of literatures adopting a BM perspective on servitization. Then, the research process is presented in Section 3 and the new business model framework in section 4. The empirical application of the framework is illustrated in section 5. Finally, section 6 discusses the findings and draws some conclusive remarks, highlighting limitations and future research directions.

2. Theoretical background

2.1 Business model (BM) concept

In general terms, a BM explains how a business creates and delivers value to customers (Teece, 2010; Baden-Fuller and Morgan, 2010). Although it has been noticed a fragmentation of researchers' perspectives regarding the nature, structure, and evolution of BM (Morris, Schindehutte, and Allen, 2005; Zott, Amit and Massa, 2011; Coombes and Nicholson, 2013), the literature generally agrees that a BM can be seen as an abstract tool providing a picture of a company's competitive situation. In fact, a BM can be used to describe and analyse the business logic of a company, the value creation mechanisms and how that value is monetized, linking the "inside" with the "outside" of the firm, i.e. suppliers and customers (Wirtz et al., 2016; Baden-Fuller and Mangematin, 2013; Osterwalder and Pigneur, 2010). Therefore, the BM represents a management method that supports strategic decision-making (Osterwalder, Pigneur and Tucci, 2005).

BM frameworks can be defined as structured ways of describing BMs, encompassing a set of internal and external components that have to be considered when designing, evaluating, and managing BMs (Al-Debei and Avison, 2010; Wirtz et al., 2016). Components usually represent may be further formally described with specific variables. Several BM frameworks appeared in the literature (e.g. Chesborough, 2007; Johnson, Christensen and Kagermann, 2008; Lindgardt et al., 2009; Demil and Lecoq, 2010; Osterwalder and Pigneur, 2010; Baden-Fuller and Mangematin, 2013). Wirtz et al. (2016) observe that the majority of these works focus on few components. Among the few contributions that give a more comprehensive perspective, one that has gained consensus and diffusion in the managerial and academic communities is the business model Canvas (Osterwalder and Pigneur, 2010). It is based on nine “building blocks” that reflect the most common key components found in the business model literature (Al-Debei and Avison, 2010; Baden-Fuller and Mangematin, 2013; Wirtz et al., 2016). These components are (Osterwalder and Pigneur, 2010):

- *Customer segments*: groups of people or organizations a company aims to reach and serve;
- *Value propositions*: products and services that create value for a specific customer segment;
- *Distribution channels*: company's interface with its customers;
- *Customer relationships*: types of relationships a company establishes and maintains with specific customer segments;
- *Revenue streams*: revenue a company generates from each customer segment;
- *Key resources*: assets required to offer and deliver the aforementioned elements;
- *Key activities*: activities involved in offering and delivering the aforementioned elements;

- *Key partners*: network of suppliers and partners that support the business model execution;
- *Cost structure*: costs incurred when operating a business model.

The BM Canvas allows distilling the multiplicity of business model components into a simple and parsimonious framework (Aziz et al., 2008). For this reason, it has been adopted by several researchers and practitioners, proving its completeness and adaptability to various industries and topics (e.g. Zolnowski et al., 2014; Wiesner et al., 2014; Gibson and Jetter, 2014). Thus, it is not surprising that it has also been applied to PSS settings (e.g. Gelbmann and Hammerl, 2015; Azevedo and Ribeiro, 2013; Barquet et al. 2013; Witell and Löfgren, 2013; Van Ostaeyen et al. 2013).

2.2 PSS business model frameworks in the literature

Although the literature pointed out that the required strategic realignment needed in the servitization process should be framed in a structured BM (Kindström, 2010; Kindström and Kowalkowski, 2014; Helms, 2016), PSS BMs have received little attention by research (Boons and Lüdeke-Freund, 2013; Reim et al., 2015).

Adopting the Canvas structure, however, the main elements that characterize a PSS BM can be identified (Adrodegari and Saccani, 2017). Table 1 traces back the elements that describe PSS BMs according to the relevant literature to the nine components of the BM Canvas

[Insert Table 1 near here]

Table 1 – Relevance of BM components for PSSs

Existing PSS BM frameworks (e.g. Kujala et al., 2011; Barquet et al., 2013; Ferreira et al., 2013; Kindström and Kowalkowski, 2014) generally refer to (some of)

these key components, but a more fine-grained identification of variables characterizing each component is usually lacking (Adrodegari and Saccani, 2017). However, such a detailed level of formalization would enable a more thorough understanding of the characteristics of servitization, and support PSS BM innovation. In fact, practitioners could assess how their current BM is configured, outline the characteristics of their future one, identify the gaps with respect to all relevant variables, and define actions to move towards a new PSS configuration. The BM framework developed and presented in this paper moves from this gap.

3. Research process and method

The research process consisted of two main activities (see Figure 1): 1) developing the PSS BM framework based on the scientific literature, and 2) applying it empirically, which allowed both refining it and exploring its managerial implications.

In order to develop the PSS BM framework, we reviewed the literature that adopts a BM perspective in servitization and PSS. In order to do that, we borrowed an approach often used when relevant research is spread across a number of different literature streams (e.g. Rapaccini and Visintin, 2015). We started our analysis with recently published reviews in the marketing and operations management fields (e.g. Carlborg, Kindström, and Kowalkowski, 2014; Eloranta and Turunen, 2015; Reim et al., 2015; Tukker, 2015; Qu et al., 2016; Brax and Visintin, 2017; Baines et al., 2017; Ziaee Bigdeli et al., 2017) and then backtracked through citations to identify other relevant contributions. At the same time, as a systematization of the current knowledge on the topic could not rely only on the sources adopting a BM approach, we also searched for relevant literature that deals with each of the BM components in Table 1.

[Insert Figure 1 near here]

Figure 1 – Research process

Building on the analysed body of literature, we developed a first version of the PSS BM framework, where each component was operationalized with variables derived from the literature. The framework was then applied in three companies, in order to test its comprehensiveness and managerial applicability. The studies were carried out within the T-REX project, funded by the European Commission under the 7th Framework Programme. The three companies involved were selected as representative of different sizes and industries, namely machine tool, materials handling and automation. The companies are briefly described in the Table 2.

[Insert Table 2 near here]

Table 2 – Case companies description

In order to enhance the reliability and validity of the data collection and elaboration activities (Voss, Tsikriktsis and Frohlich, 2002), we designed a specific research protocol. The protocol was based on the PSS BM framework, as it defines the list of aspects to be investigated, and was used as a guideline during the semi-structured interviews and workshops carried out in each company. More precisely, for each company the application started with a half-day workshop that involved the CEO and/or some top managers. The main objectives of the initial workshop were to establish a shared language, illustrate the PSS BM framework and define the unit of analysis (i.e. scope and boundaries of the work). Then, following the guidelines provided in the research protocol, we performed detailed interviews with different roles such as service manager, sales and marketing manager, R&D manager and information systems manager. Each interview lasted between 1 and 2 hours and involved each manager

individually. The main evidences were then shared, discussed and validated during a second company workshop.

At this stage, an inter-company workshop was performed, in order to facilitate a cross-case discussion. Experts from other research organizations taking part to the T-REX project were also involved, in order to collect external opinions. The initial interviews and the inter-company workshop triggered the revision of the PSS BM framework. In fact, some of the variables initially presented in the framework were considered not relevant for describing the companies' BMs (e.g. in the *Value proposition* block we removed the variables related to the product characteristics such as "average life-cycle" or "modularization") and others have been added or reviewed (e.g. the *Key activities* component was reviewed in order to better replicate the development and delivery processes of industrial service offerings).

Then, the final version of the framework was used in a company workshop. Expectations and preliminary ideas were discussed with the management in order to define the new PSS BM concept, identifying the product/services in target and the revenue streams. This concept was then translated into detailed BM characteristics, structuring and mapping the new idea with the PSS BM framework. A final workshop was then performed with each company to point out the relevant gaps and the most appropriate actions needed to successfully deploy the new BM.

As an example of how the framework works in a real-world setting, section 5 describes the case of KINE Robot Solutions. This company was selected since it developed the most radical BM innovation among the three cases, moving from a very traditional product-based BM to a result-oriented BM. Moreover, the KINE case allowed testing the model in a very small enterprise, with a product-centric culture and scarce resources. The development of instruments to support the PSS transition in SMEs

and micro-firms is, in fact, and area where further research is necessary (Gebauer et al., 2012; Kowalkowski et al., 2013).

4. The PSS business model framework

In this section we propose a new two-level hierarchical framework that encompasses a broad set of components to be evaluated and characterized when designing the transformation from products to PSSs. In particular, as mentioned in section 2, the proposed framework uses at the first level the components of the BM Canvas, except for the fact the components “Customer Segments” and “Customer Relationships” have been unified within a single component named “Customers”. Such choice guarantees a comprehensive approach to the characterization of PSS BMs, and also the adoption of a shared terminology that facilitates the understanding of the phenomenon among researchers and practitioners alike. This contrasts the terminological fragmentation found both in the BM and PSS literature to date (Wirtz et al., 2016; Tukker, 2015). To fill the need of a greater level of detail in describing PSS BMs, at the second level of the framework each component has been operationalized through specific variables (from two up to five for each component, resulting in a total of 25 variables) according to the process illustrated in section 3. These variables, derived from the literature, correspond to the most relevant aspects that need be characterized in order to describe each BM component in the case of PSS. The framework is described in Table 3, which also includes key managerial questions connected to each variable, to make explicit the practical utility of the framework to managers, thereby facilitating understanding, reflection and decision-making.

[Insert Table 3 near here]

Table 3 – PSS business model framework

5. Application – findings from the KINE case

This section describes the application of the framework to KINE, to discuss how companies face the challenges implied by the move from products to PSSs. The company is a Finish SME with 12 employees and a turnover of around 2 million € KINE designs and delivers robot systems since 2000, providing solutions for production process automation (e.g. packing, palletizing, welding, measuring, material handling, etc.) and traditional product-related services such maintenance and spare parts. The company sells both stand-alone robots and complete systems, designed and assembled based on specific customer needs and delivered as turnkey solutions. Usually, a solution is composed of both standard and non-standard components: in several cases robots, sensors, PLC and electrical components are standard and purchased from long-term suppliers, while the gripper and positioning are customized based on customer's production process. Consequently, interactions with customers are very close during the system design phase, where KINE faces all the typical challenges of One-of-a-kind production Engineer-To-Order companies (Adrodegari et al., 2015). Interactions become looser after system delivery, or may end totally in case the customer decides to carry out after sales services internally or source them from other companies. Also for this reason, the company does not manage systematically customer information, and the majority of the data is collected in MS Excel sheets, with little or no data analysis carried out to develop knowledge (e.g. concerning systems failures). On the contrary, as customer order planning, system production and delivery are very critical activities, the company adopted a specific project management software. A software tool is in place also to handle service requests: however, it is not integrated with the Enterprise Resource Planning system and has been used so far mainly for administrative issues. This picture is coherent with the product-centric approach traditionally adopted by the

company: the service business was underdeveloped as services are not sold proactively and a structured service business function is missing.

Therefore, in order to gain competitive advantage against larger competitors, the company decided to develop a new PSS business model where the customer will pay based on the output of the production process (pay-per-volume or outcome). In the following table the main characteristics of this new BM are illustrated through the PSS BM framework developed in this paper.

[Insert Table 4 near here]

Table 4 – KINE’s new PSS business model configuration

The application of the framework allowed the management to develop a clear understanding of the PSS BM concept, and provided a structured description of the new BM. Moreover, it triggered the identification and undertaking of the transformations needed.

Several actions, in fact, were needed to achieve the new BM configuration (see also Table 4). First, the company operational capabilities and human resources had to be aligned with the requirements of the new value proposition: as an example, sales and marketing personnel needed to develop the capabilities to communicate the new offerings to customers and needed to be more integrated with the service function.

Moreover, changes were required also outside the company: the establishment of new strategic partnerships (service provider, financing and insurance companies) are needed to sustain the new BM in the financial, logistics, offering, operations and maintenance activities. Respecting the promises is vital for the achievement of customers’ objectives in pay-per-outcome, and the service processes were redesigned to be fault-proof. In

addition, in the new BM, remote diagnostics and product condition analysis are crucial for the company in order to minimize maintenance costs and maximize the value generated by the product use. Therefore, data processing and interpretation capabilities, remote monitoring and condition-based maintenance systems have been developed by the company, also thanks to the EU funded project mentioned in section 3.

Based on the new PSS offering, KINE has recently made a successful tender for a contract with the Finnish Transport Safety Agency, providing marine vessel fuel sulphur content (FSC) remote measurements, as a service. More specifically, the company is paid for every valid FSC measurement that can be connected to a specific marine vessel. To do so, the company has set up multiple measurement stations in the Finnish archipelago near ports with high incoming and outgoing traffic.

Such pilot project helped KINE testing and fine-tuning the BM of the new PSS offering. According to the company's CEO, this is a good example of the value that the PSS BM framework described in this paper can provide to practitioners:

“The knowledge acquired with this project helped us to develop a completely new value proposition that differentiate us from competitors. Moreover the tool (i.e. the framework) let us save time in developing the new offering, as all the issues that need to be managed were known in advance. In fact, the tool allows us to show to our customer that behind the new offering a very structured business model was designed to ensure the credibility of our proposal.” (CEO, KINE).

6. Conclusion

6.1 Research and managerial implications

Despite the acknowledged importance of the service business, capital goods companies frequently struggle to reconfigure their business models and increase their service

orientation. The adoption of a business model approach provides a comprehensive understanding to companies aiming to successfully leverage, coordinate and align all the transformations required to servitize, but little research to date has focused on the characterization of PSS business models.

The conceptual output of this paper is a two-level framework, illustrated in Table 3. At the first level, the PSS BM framework is anchored to the general BM literature, and adopts the BM canvas perspective (Osterwalder and Pigneur, 2010) to provide a holistic representation of a PSS BM. This contributes to the harmonization of the terminology adopted by the scientific literature, facilitating a common understanding of the phenomenon for both researchers and practitioners (Tukker, 2015; Wirtz et al., 2016). At the second level, a set of 25 specific variables describe in a detailed way each dimension. Each variable is described and related to the extant literature, and associated to a managerial challenge. The framework constitutes an original contribution of this work, as it connects different aspects that have been often separately addressed by the literature, and contributes to systematize the PSS and servitization literature. It provides a greater formalization of PSS business models, identifying its main components and the relevant variables to characterize each component. Each variable, in turn can be configured among a set of options.

The proposed PSS BM framework can be useful both to researchers and practitioners to characterize and compare different PSS BMs (Tukker, 2004). This is particularly useful when multiple BMs need to be developed and implemented, due to the different types of service offerings delivered and the related revenue models. The coexistence of multiple BMs is a rather under-investigated topic (Benson-Rea et al., 2013; Kowalkowski et al., 2015). The proposed framework can help companies formalizing the existence of these different BMs, highlighting their differences and

commonalities. In fact, the coexistence of multiple BMs, though generating additional complexity, may also lead to greater efficiency in resource allocation and effectiveness in capabilities exploitation, in particular when moving to PSS. As well, the proposed BM framework can support companies in making the alternative business ideas more concrete. In particular it guides companies in specific reasoning concerning the revenue model, the new cost sources arising, the risks and investments needed to implement each BM. Although the specific and complex issue of selecting among alternative PSS BMs (see for example Battochio et al., 2016) goes beyond the scope of this paper, the proposed framework can help companies in taking into account all the relevant aspects that need to be considered, enabling a comparison between the alternatives.

In addition to such an analytical use, as the empirical application shows, the framework can be seen as a practical management tool that provides prescriptive guidelines on how to organize for the provision of PSSs. In fact, the framework provides manufacturers with a holistic approach that can be used to carry out the transition effectively, helping them to take into account the relevant elements that need to be designed to govern the implementation of a PSS BM and guide strategic decisions. In particular, managers can use the proposed framework to understand where their current business model stands, identify where they want to go and thus point out and address the relevant areas to successfully deploy the new PSS configuration. As shown by the case study in section 5, this can be of particular help to SMEs that, due to limited internal resources and limited ability to define a service strategy (Kowalkowski, Witell and Gustafsson, 2013), may need a rigorous yet practical methodological support to undertake such an important change, thus reducing the risk of failure.

6.2 Limitation and research opportunities

As with any research, this study comes with limitations, some of which offer fruitful avenues for research. First, the extension of the empirical research to different sectors would support a greater generalization of the findings. As an example, starting from the theoretically-grounded framework, future research should perform explanatory surveys to test the significance of the variables in different industry sectors.

Second, although the framework provides a detailed and structured description of the PSS BM elements, it adopts a rather static approach. Future research may use this framework to define archetypal BM types that can describe the strategic shift from products to solutions along different service growth trajectories (Kowalkowski et al., 2015), by providing a theoretical configuration of each variable in different BM types.

Finally, since as mentioned before a company may deploy multiple business models simultaneously to serve different markets or customers (Benson-Rea et al., 2013), future research may use the PSS BM framework developed in this paper to analyse the interplay between variables and components when multiple BMs have to be configured.

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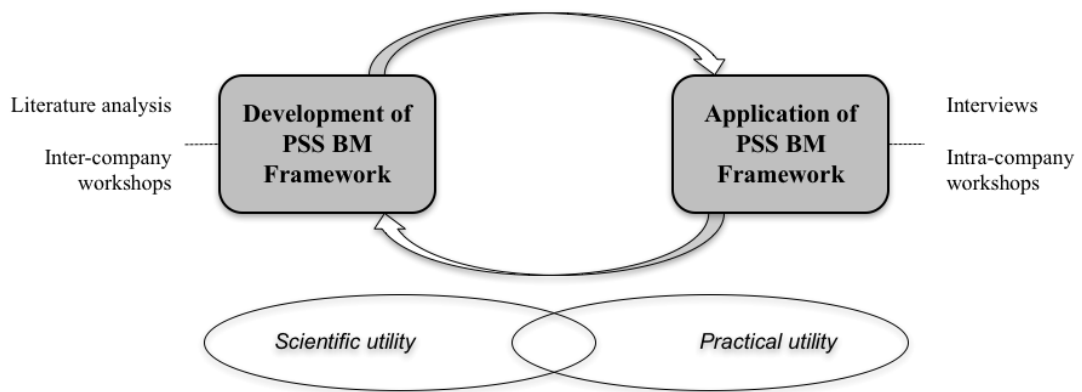


Figure 1 – Research process

BM Component	Relevance for PSS
Value proposition	Defining PSS value proposition is more than understanding what services to offer and how to develop a coherent portfolio (Kindström and Kowalkowski, 2014). In PSS, a switch from value-in-exchange to value-in-use occurs (Vargo and Lusch, 2004; Ng, Maull, and Yip, 2009; Grönroos, 2011): the value for the customer can be generated in various way, introducing different configurations of value proposition (Tukker, 2004; Smith, Ng and Maull, 2012; Brax and Visintin, 2017). As an example, customers may perceive as a direct source of value the ownership of the product, or vice versa value can be generated by using the product without having the ownership of it (Kujala et al., 2010; Barquet et al., 2013; Reim et al., 2015). In PSS BMs, these different approaches generate new different configurations of company/customer responsibilities (Ferreira et al., 2013; Gelbmann and Hammerl, 2015).
Customer segments	Addressing the right customer segment with the appropriate value proposition is a critical factor for the success of the PSSs (Kindström, 2010): in fact, not all types of value propositions fit all customers (Rexfelt and Hiort af Ornäs, 2009). In PSSs, an effective value generation is achieved when a fit between the company's and customers' BMs occurs (Nenonen and Storbacka, 2010; Ferreira et al., 2013). Thus, it is critical to define the target customer group, in order to understand how customers' perception, depending on their culture or mindset, can influence a specific value proposition (Reim et al., 2015; Storbacka et al., 2013).
Customer relationships	In PSSs, customer relationships (e.g. customer closeness and customer focus) are critical success factors (Reim et al., 2015; Kindström, 2010; Davies et al., 2007; Tukker, 2004; Gebauer et al., 2005; Galbraith, 2002). In fact, it is important to define which kind of interaction has to be established with the customer in order to enable the value delivery and maintain it throughout the product lifecycle (Meier, Roy and Seliger, 2010; Barquet et al., 2013; Liu et al., 2014). Moreover, increased customer interaction (in time and intensity) is a distinguishing factor of servitized BMs (Azarenko, Roy, Shehab, and Tiwari, 2009). This encompasses also the definition of the extent to which the company and the customer have to share information (Reim et al., 2015; Windhal and Lakemond, 2010).
Key resources	Companies need to acquire/develop a whole new set of distinctive resources: competencies to deal with customers should be developed, people trained and sometimes additional personnel recruited (Ulaga and Reinartz, 2011; Baines et al., 2013; Kindström and Kowalkowski, 2014). Manufacturers need financial resources to sustain the transition to different revenue models (Lay et al., 2009; Reim et al., 2015) and new technologies to better manage, analyse and share the wider amount of data that have to be generated and controlled to sustain PSS business models (Meier et al., 2011; Barquet et al., 2013; Liu et al., 2014).
Key activities	It identifies the processes that are critical for the success of service development and delivery (Lay et al., 2009; Kindström and Kowalkowski, 2014). In PSSs companies may outsource activities that previously were performed internally and may acquire resources from outside their borders (Storbacka, 2011; Dimache and Roche, 2013). Moreover, service innovation may require industrial firms to change their internal organisation (Kindström and Kowalkowski, 2009) in order to deploy new service-related activities (Rapaccini et al., 2013; Cavalieri and Pezzotta, 2012).
Channels	As it is very important to understand how the new value proposition is delivered to customers, in PSS BMs companies need to rethink the way through which they create awareness on the new service offering and communicate the new added value (Reim et al., 2015). In PSSs environments this can lead to reconfigure sales and after-sales channels by internalizing/externalizing specific resources as well as to acquire or develop new kinds of competencies (Storbacka, 2011; Kindström and Kowalkowski, 2014).

BM Component	Relevance for PSS
Key partners	It defines the composition and structure of the network that is needed to sustain the PSS BM. Defining the types of actors through which share responsibilities and value generated with the new offering becomes crucial (Ferreira et al., 2013; Liu et al., 2014; Reim et al., 2015). Moreover, in PSS BMs, it becomes critical moving from short to long term or from price based to strategic based relationships (Storbacka, 2011; Barquet et al., 2013).
Cost structure	As cash-flow structure can radically change in PSSs (Mont et al., 2006; Eggert et al., 2014), it defines how financial and accounting practices need adaptations (Meier et al., 2010; Barquet, 2013; Reim et al., 2015). Traditional assessment procedures of investment planning or cost management are no longer sufficient, since the timescale of financial flows may change considerably (Neely, 2008; Richter, Sadek and Steven, 2010; Storbacka, 2011; Settanni et al., 2014). Moreover, risk management activities become critical (Zheng et al., 2015).
Revenue model	It defines how companies need to structure their sales to customers in different ways based on the value for the customer generated (Kujala et al., 2010; Barquet et al., 2013; Kindström and Kowalkowski, 2014). With the shift from ownership to access, the revenue model evolves from one-off transactions and to continuous payment over time to outcome- or output-based (Tukker, 2004; Kindström and Kowalkowski, 2014). However, rather mixed payment mechanisms are quite common in the case of PSSs (Van Ostaeyen et al., 2013; Rapaccini, 2015).

Table 1 – Relevance of BM components for PSSs

Company	Description	Strategic objective of the move to PSS	Research contribution
A	<ul style="list-style-type: none"> ▪ Spanish company ▪ 160 employees ▪ Focuses on the sales and rental of forklift trucks. 	<ul style="list-style-type: none"> ▪ Further exploitation of the rental fleet (lifecycle extension) ▪ Maintain strong link with current BM, current customers and their needs 	Test the model in a (already) servitized environment.
B	<ul style="list-style-type: none"> ▪ Italian company ▪ 350 employees ▪ Manufacturer of high-end numerical controls, and high speed milling machines. 	<ul style="list-style-type: none"> ▪ Use of monitoring technologies to enable advanced services ▪ Service business growth (revenue, profits) 	Test the model in a traditional product-centric company that aims to enlarge its service portfolio (incremental innovation).
KINE	<ul style="list-style-type: none"> ▪ Finnish company ▪ 12 employees ▪ Operates in the field of robot system integration. 	<ul style="list-style-type: none"> ▪ Develop new revenue mechanisms to compete against larger competitors ▪ Create a new service-based culture (company and customers) 	Test the model in a product-centric company that aims to move towards a completely new PSS business model (radical innovation).

Table 2 – Case companies description

Component	Variable	Main change in PSS BMs	Managerial questions (challenges)
Value proposition	Value for the customer	Defining value for customer (Windahl and Lakemond, 2010) is the starting point for PSSs definition (Payne and Holt, 2001; Mont, 2002; Vargo and Lusch, 2004; Pawar, Beltagui and Riedel, 2009). In PSS value for the customer can be generated by the reduction of initial investment, minimization and/or guarantee of operational cost, or functional guarantee and minimization of risk for the customer over the lifecycle (e.g. Morris et al., 2005; Isaksson, Larsson, and Rönnbäck, 2009; Barquet et al., 2013).	<ol style="list-style-type: none"> 1. What are the main sources of value for the customer in the new BM? 2. Which value for the customer has to be delivered with the new BM?
	Creation of value	In product-centric models value is created in the firm and then exchanged with the customer, as value is an embedded attribute of the product (Kowalkowski, 2011). Instead, in PSSs value is interactional (Pawar et al., 2009) and co-created (Prahalad and Ramaswamy 2004; Sheth and Uslay, 2007), as it is generated through the access or the usage of a product (Lay et al., 2009; Storbacka et al. 2013). Thus, a switch from value-in-exchange to value-in-use occurs (Vargo and Lusch, 2004; Ng et al., 2009; Grönroos, 2011): value cannot be objectively determined or delivered by the provider in isolation (Vargo and Lusch, 2004; Smith et al., 2012).	<ol style="list-style-type: none"> 1. Which current or new solutions does the company want to deliver with the new business model? 2. How will the value creation process occur (lifecycle phase, activities and processes involved, expected role of customer and supplier)?
	Product ownership	The ownership of the physical product, that describes who has the product right after the contract expires (Lay et al., 2009), is not obvious in PSS business models: it can either be passed to the customer or remain with the manufacturer. The "non-ownership" concept is the basis for several types of PSS BM (Tukker, 2004). Moving towards PSSs, the reliance on the product as the core component decreases and the customer's need can be formulated in more abstract terms.	<ol style="list-style-type: none"> 1. Does the customer want to: i.) Own the product? ii.) Gain access to the product (e.g. lease, rent)? iii.) Benefit from the results of the product usage? 2. Would the company be inclined to remain the owner of the product during its whole life-cycle?
	Service offering	The extension of service components in the total offering is a key trigger for providing PSSs (Davies, 2004). Different classifications describe the evolution of the offerings in PSS BMs: e.g. Mathieu, 2001; Ulaga and Reinartz, 2011; Gaiardelli et al. 2014; Kindström and Kowalkowski, 2014. Generally, as offerings become more servitized, companies include advanced services and services supporting the customer (Baines et al., 2017; Paiola et al., 2013).	<ol style="list-style-type: none"> 1. Which current or new services does the company want to deliver with the new business model? 2. Moreover, identify the width of service offering, in terms of incidence of base, intermediate and advanced ones and relevance of different lifecycle phases.

Component	Variable	Main change in PSS BMs	Managerial questions (challenges)
Customers	Customer interactions	In PSSs, a tight relationship and improved interaction between the company and its customers are important success factors (e.g., Cova and Salle, 2008; Davies et al., 2007; Galbraith, 2002), enabling the mutual creation of value. In fact, the success of the value co-creation process relies heavily on customers' efforts and involvement (Sheth and Uslay, 2007). Increased customer interaction is therefore a distinguishing factor for PSS BMs (Kindström, 2010; Spring and Araujo, 2009; Vargo and Lusch, 2008, Storbacka et al., 2013). Customer interaction and participation in design, production, sales and delivery are essential characteristics of PSSs (Kindström and Kowalkowski, 2009).	<ol style="list-style-type: none"> 1. Are closer relationships with customers needed in the new PSS BM? 2. How customer interactions should be designed?
	Customers' information sharing	Information sharing between the company and the customer is a prerequisite (or a consequence) to establishing close customer relationships (Reim et al., 2015; Kindström, 2010; Mont, 2002). Moreover, collecting/exchanging information and realizing how to use data allows the manufacturer to become knowledgeable about customer operations (Uлага and Reinartz, 2011). In fact, customers' provision of information and guidance about their operations and policies helps the supplier provide better services (Kindström and Kowalkowski, 2014).	<ol style="list-style-type: none"> 1. Is information sharing to be enhanced in the new BM? If so on which aspects? 2. Which operational and strategic benefit could be achieved? 3. Does the company need to put in place new actions for that (information tools, increase "trust" with partners, change sales/service people mind-sets, ...)?
	Customer and market insight	In PSS, as the creation of value has to be understood through the eyes of the customers (Brady et al., 2005; Davies, 2004), it becomes critical to achieve an excellent understanding of customers, their operations and business (Kindström, 2010; Reim et al., 2015). Consequently, the company should acquire and analyse data and information both about customer problems and their operations in order to create and deliver a clear value proposition that matches real customer preferences and needs. Moreover, when it understands its customers, a company can influence their needs (Payne et al., 2008).	<ol style="list-style-type: none"> 1. Does the company need to collect information about the customers for the new BM? 2. Which kind of information? 3. How can it be transformed into valuable knowledge?
	Target customers and segments	A company has to develop segment-specific strategies, including business goals (Foote et al., 2001; Miller et al., 2002). Therefore, different criteria should be implemented to segment and analyse (potential and actual) customer needs. In particular, in PSS BMs companies need to develop customer-specific value propositions, which are unique and linked to critical business concerns of an individual customer (Storbacka, 2011). For this reason, the company has to define focus markets, segments and customers for its business (Storbacka, 2011), In PSSs, customers can be segmented using multiple and advanced criteria that consider different types of user behaviour, since the new offering involves changes in ownership, responsibility, availability and cost.	<ol style="list-style-type: none"> 1. Which current or new customer(s) segments does the company want to address with the new business model? 2. Which customer segmentation criteria will help in the definition and sale of the new value proposition? 3. Is the information needed to deploy the new customer segmentation available? If not, how can it be gathered?

Component	Variable	Main change in PSS BMs	Managerial questions (challenges)
Key Resources	ICT and monitoring technologies	ICT and digital technologies enable PSS BMs (Becker et al., 2013; Ardolino et al., 2017). ICT systems allow to share information and knowledge extracted from data collected among different functions (Storbacka, 2011) and also towards customer and partners. Thus traditional software systems (e.g. ERP, CRM, PLM, PDM, SRM) should be fully integrated, and applications that support supply chain management and collaboration activities should be implemented (Neff et al., 2014). PSS BMs require the enhanced usage of remote technology (Neff et al., 2014), such as the Internet of Things: embedded ICT systems become very sophisticated and open up possibilities for remote services such as supervision, maintenance, process improvements, and upgrades.	<ol style="list-style-type: none"> 1. Which information systems are needed in the new BM to collect and manage data and information related with customers, installed products and product-enabled processes? 2. Which (new) digital technologies should be developed to implement the PSS BM?
	Installed base information	Product installed base represents a unique asset for most manufacturing firms (Wise and Baumgartner, 1999; Ulaga and Reinartz, 2011). Particularly in PSS BMs, managing the installed base is salient, as it is a source of knowledge and creates critical insights about the products' operation, enabling new service offerings and revenue models (Storbacka, 2011). The level of control that a company exerts on data and information generated by the customer during the usage of the product is crucial: collecting and updating historic data after repair and maintenance events, the use of condition monitoring for preventive maintenance and optimising the customer processes (Neff et al., 2014) depend on the company's control on installed base information.	<ol style="list-style-type: none"> 1. Does the company have any control over its installed base? 2. Which information is critical to gather valuable customer or product knowledge from the field? 3. How can information from the installed base (customer, location, maintenance history, usage history) be gathered?
	Human	In PSS BMs, a shift of mindset and corporate culture is required to increase the service orientation of the organization at all levels (Gebauer et al., 2005; Barquet et al., 2013). Thus, companies must make considerable investments in human resources to develop new competencies, re-configure existing ones (Kindström and Kowalkowski, 2014; Ulaga and Loveland, 2014; Storbacka, 2011; Ulaga and Reinartz, 2011; Gebauer, 2011; Kindström, 2010; Helander and Möller, 2008), or to hire new personnel (Ulaga and Reinartz, 2011; Gebauer, Paiola and Edvardsson, 2012; Kindström and Kowalkowski, 2014).	<ol style="list-style-type: none"> 1. Which kind of new and distinctive skills have to be developed or strengthened in the new BM? 2. How can these be achieved (training, new personnel, new procedures, new information systems, ...)?
	Financial	In PSS BMs the need for capital is high, since the company may remain the owner of the product and the payback period of a product-service system is usually longer than of a physical product sales (Tukker, 2004; Barquet et al., 2013). Companies must have adequate financial resources or receive support from financing partners to bridge this period (Mont, 2002). Moreover, offering a wide range of services in this business model and taking over operational risks also implies greater financial risk for the company (Kindström and Kowalkowski, 2014; Alghisi and Saccani, 2015).	<ol style="list-style-type: none"> 1. What is the amount of financial resources needed to deploy the new PSS BM? 2. What partners should be involved to cover the financial risks (e.g. banks, insurance companies, ...)?

Component	Variable	Main change in PSS BMs	Managerial questions (challenges)
Key activities	Product development and design	In PSS BMs, to meet product and service design requirements, special emphasis is placed on aligning physical product characteristics with service (Reim et al., 2015). Moreover, the company is usually responsible for all lifecycle costs in PSS BMs. This provides a powerful incentive to design a product that minimizes the overall lifecycle cost (lifecycle extension and minimization of operating cost), easy to maintain (Azarenko et al., 2009) and whose elements can be re-used at the end of the products life (Tukker 2004; Datta and Roy, 2010) and. Several product properties such as the ability to be maintained, upgraded, and reused easily, can be identified and improved in the design phase in order to facilitate the provision of product-related services (Badham et al. 2000; Abdalla, 1999) and increase the value creation of the new business model (Sundin and Bras, 2005; Gaiardelli, Cavalieri and Saccani, 2008).	<ol style="list-style-type: none"> 1. Which (product) features should be enhanced in the new BM (e.g. reliability, serviceability, durability, end-of-life, modularity)? 2. Which redesign actions should be carried out? 3. Is an increased data collection and transmission capability (e.g. sensors, IoT) required?
	Services design and engineering	Refers to the ideation/innovation of service components that can improve PSS offerings to better fit customer needs and make value creation possible (Tuli, Kohli and Bharadwaj, 2007; Pawar et al., 2009; Kindström and Kowalkowski, 2009). New service development and service engineering activities may help product centric-firms to successfully extend their service offering and its integration level with the tangible component (Rapaccini et al., 2013). Specific methods and roles should be involved (Cavalieri and Pezzotta, 2012)	<ol style="list-style-type: none"> 1. How can an explicit strategy, procedures, roles and tools for new service development be introduced in the new BM?
	Products and services configuration support	Refers to the definition of a new offering with specific product and services configuration to create value for the individual customer (Tuli et al., 2007; Storbacka, 2011). PSS offerings are complex: focusing on value-driven communication becomes central (Reim et al., 2015) as the company needs to show to potential customers the value of the new offering. To this end, specific strategies and methods (e.g. Total Cost of Ownership, Service Level Agreement) are essential to help customers appreciate the distinctiveness and benefits of PSS (de Brentani, 2001). Thus, front-line employees should have sufficient knowledge in order to convincingly sell and transmit the new value to the customers (Kindström and Kowalkowski, 2009; Kindström, Kowalkowski and Alejandro, 2015). Often, a new reward system is needed to promote service sales and change the behaviour of a product-centric sales force (Reinartz and Ulaga, 2008; Kindström, 2010; Kindström and Kowalkowski, 2014).	<ol style="list-style-type: none"> 1. Which tools can support the configuration of the individual PSS offering for a customer 2. Which methods can be used to best show the value for the customer of the new offering (e.g. Total cost of ownership or lifecycle costing evaluation, development of Service Level Agreements, ...)?

Component	Variable	Main change in PSS BMs	Managerial questions (challenges)
Key activities	Products and services delivery	In PSS BMS, both service delivery planning and execution activities need to be closely managed (Meier et al. 2013) in order to guarantee that integrated systems can be made available in an efficient manner (Storbacka, 2011; Tulli et al. 2007). To enable quick ramp-up of delivery operations and secure long-term embeddedness with customers (Storbacka, 2011), the delivery process should be carefully monitored. It is therefore important to verify and report both to customers and internally to the company that the planned value has been created, and to document successful deliveries (Kindström and Kowalkowski, 2009). Service delivery becomes more than providing spare parts, operating information and routine maintenance: remote diagnostics and product condition analysis are crucial to minimize lifecycle costs and maximize the value generated by the product (Meier et al., 2010; Rapaccini and Visintin, 2015).	<ol style="list-style-type: none"> 1. Which indicators have to be defined and monitored to track the effectiveness of the PSS delivery? How will they be communicated to the customers? 2. Which set of Key Performance Indicators (KPIs) better describe the efficiency and effectiveness of PSS delivery? How can they be timely monitored and shared within the organisation and the partner network?
	Intra-firm collaboration and integration	PSS BMs need to establish formal processes and mechanisms to carry out cross-functional activities (Kindström et al., 2015) and achieve cross-functional integration (Storbacka et al., 2013; Nordin and Kowalkowski, 2010). In particular, PSS BMs especially call for collaboration between the service organization and R&D and/or product development (Kowalkowski, 2011; Kindström and Kowalkowski, 2014). Moreover, as the service offered becomes more sophisticated the need arises for effective coordination of sales and after-sales processes in every step of the product lifecycle, providing the customer with a unique and direct touch-point (Kindström et al., 2015). Thus PSS BMs require a collaborative management and the measures used to control the business have to acknowledge this cross-functional nature (Storbacka, 2011).	<ol style="list-style-type: none"> 1. Is the collaboration among service and technical functions, marketing/sales personnel, more important in the new BM? On which aspects in particular? 2. Are practices to enhance internal collaboration already in place or being designed?
Key Partners	Network	Providing PSSs increase complexity in the company's operations (Reim et al., 2015; Barquet et al., 2013) and thus firm must develop new networks infrastructures (Gao et al., 2011) to share capabilities and jointly create value (Aurajo and Spring, 2006; Lusch and Vargo, 2006). The network should be designed concurrently with the new value proposition (Aurich et al., 2006; Mont et al., 2006; Ward and Graves, 2007), specifying each partner's role and value throughout the product lifecycle (Storbacka, 2011). Thus, the establishment of such a network requires the identification of actors and of the core competencies they can provide (Mont, 2002; Barquet et al., 2013). Finding partners that can add value to the new offering (Kindström, 2010) is critical, and supplier selection should be based on strategic consideration rather than price based criteria (Mont, 2002; Aurajo and Spring, 2006; Lusch and Vargo, 2006; Kindström, 2010).	<ol style="list-style-type: none"> 1. Identify the main types of (relevant) suppliers involved in the new BM and, for each type: specify if you need new suppliers with respect to the current BM; specify if you need to build long-term partnership with each type of suppliers or not; add any other category if useful and report the entire list. 2. Would be possible to configure and establish a network of suppliers and partners to acquire resources, capabilities and even reduce risks of the new business model?

Component	Variable	Main change in PSS BMs	Managerial questions (challenges)
Key Partners	Supplier relationship	<p>In PSS BMs, strong relationships with critical suppliers are needed (Gebauer et al., 2013): actors within the new network become increasingly dependent on each other's processes, which requires harmonization across and within organizational boundaries (Brady et al., 2005; Oliva and Kallenberg, 2003; Storbacka, 2011). In particular, the management of upstream relationships with the network in charge of providing services is critical in a servitized environment (Martinez et al., 2010, Gebauer et al., 2013). After choosing partners, much effort is needed to develop ways to coordinate the relationships and share the right information efficiently in the network (Schuh et al., 2009). In fact, given the effort needed for setting-up a long-term relationship, this should rely on cooperation and on a significant and bidirectional information exchange (Saccani et al., 2014). Thus, the interface and the communication with partners may require specific attention, in order to secure transparency and long-term quality (Storbacka, 2011).</p>	<ol style="list-style-type: none"> 1. Are long terms relationship and information sharing with partners crucial in the new BM? If so with which partners? 2. Is that different from the current BM? 3. Does the company need to put in place new actions for that (information tools, increase "trust" with partners, ...)?
Channels	Sales channel configuration	<p>In PSS BMs, the sales channel should be able to create customer awareness and enable the offering evaluation. Thus, sales and marketing personnel need to develop trustworthiness, reliability knowledge/experience on the new PSS offering and becomes a resource to be used by customers for the creation of additional value (Kindström et al., 2015). Because of the increasing comprehensiveness of the company's value proposition, the sales-force should modify their sales strategy (Kindström et al., 2015). In fact, the salesperson needs to devote more attention and effort to communicating value to the customer: a direct interface with the end customer is needed in order to define selling parameters primarily driven by customer perceived value creation instead of internal cost.</p>	<ol style="list-style-type: none"> 1. Does the company need internal (direct) or external sales channels for the new BM? 2. Will they be the same as for the current BM? 3. Which actions/improvements/modification have to be done?
Channels	After sales channel and field service network	<p>A field service network is a prerequisite for successful delivery PSSs and it includes both the internal service organization and external service partners (Kindström and Kowalkowski, 2014). Since actual delivery of services becomes a key activity that can directly affect customer satisfaction and retention, a company often need to develop new resource base geared to service provision (Kindström, 2010). In fact, field technicians interact frequently with customers, and customers tend to trust them more (especially if they are located full time on customer sites), which makes them a key resource for sales (Ulaga and Reinartz, 2011). For this reason, in PSS BMs the after-sales channel should be highly integrated with the sales one, providing the customer with a unique and direct touch point that hold the entire customer related knowledge. Thus, it should be useful to establish specific, customer-focused units that can be coupled with a key account management approach (Gebauer and Kowalkowski, 2012; Kindström et al., 2015).</p>	<ol style="list-style-type: none"> 1. Does the company need internal (direct) or external after-sales channels for the new BM? 2. Will they be the same as for the current BM? 3. Which actions/improvements/modification have to be done? 4. Which degree of interaction and integration between sales and after-sales channels has to be designed? On which aspects?

Component	Variable	Main change in PSS BMs	Managerial questions (challenges)
Cost	Cost structure composition and management	When a function is sold rather than ownership, cost structures should be arranged to support a new demand of cash-flow (Barquet, 2013; Azevedo, 2015). Moreover, new non-recurring, overheads and hidden costs became relevant (Datta and Roy, 2010). They include issues such as cost of relationship management, communication costs, costs of reverse logistics and flexibility of response and costs of cultural changes or change management (Meier et al. 2010). Moreover, since the timescale of the financial flows change considerably, accounting practices need adaptations (Barquet, 2013; Azevedo, 2015). In fact, traditional assessment procedures of investment planning or of cost management are no longer sufficient in this new setting (Richeter et al. 2010; Datta and Roy, 2010). Moreover, cost control should supports sales by standard costing data on solutions and individual solution component: as pricing PSSs is much more demanding than pricing individual products, firms usually have to provide updated standard costing data.	<ol style="list-style-type: none"> 1. Which elements concerning internal organization, cost structure, and competitive factors could be introduced or raised above the industry's standard? 2. Does the company need new resources (tools, methods, competences, ...) for cost control activities in the new BM?
Cost	Risk	In PSSs, when defining a value proposition, a company should entail the risk component and define in advance how it is going to be shared among the actors involved in the new business model (Tukker, 2004; Azarenko et al., 2009; Meier et al., 2010). In fact, as moving into PSS BMs implies accepting more responsibility for the customer's operations, there is a significant risk issue to consider (Foote et al., 2001; Spring and Araujo, 2009; Nordin et al., 2011). Therefore, risk assessment and mitigation capabilities are required (Kindström and Kowalkowski, 2014; Zheng et al. 2015). Sharing uncertainty and risk with all the actors involved in the new offering is critical: companies and customers should jointly identify, plan, assess, handle and monitor these uncertainties and risks (Meier et al. 2010).	<ol style="list-style-type: none"> 1. Which type of risks does the company incur with in the new BM (e.g. financial, operational, adverse customer's behaviour, ...)? 2. Is that new compared to the current BM? 3. How can the company mitigate those risks (e.g. insurance, data collection and analysis to predict events, shared risk mechanism, risk premium, ...)?
Revenue	Revenue stream	Moving to PSS BMs, instead of one-off payments, companies can structure their sales to customers in different ways (Van Osteayen et al., 2013). Payment may be based, for example, on the availability of the product and/or service, on how often the product and/or service is used, on the end result of the use of products and/ or services (Barquet et al. 2013). The type of revenue mechanism employed is strictly linked to the chosen value proposition and depends on a number of variables such as customer maturity and the degree of a supplier company's internal focus on the customer and its business (Kindström, 2010).	<ol style="list-style-type: none"> 1. How would the company gain revenues in the new BM? 2. Identify the main company's revenue sources in the new BM product sales, corrective maintenance sales, maintenance contracts sales, product rental, spare parts sales,...

Component	Variable	Main change in PSS BMs	Managerial questions (challenges)
	Contractual agreements	Moving from cost-plus pricing to value-based pricing requires the development of a new pricing discipline (Rapaccini, 2015): risks and economic potential are hard to predict but new pricing models are essential to ensure profitability in PSS BMs (Oliva and Kallenberg, 2003; Tukker and Tischner, 2006; Neely; 2008). In particular in PSS BMs, when ownership is not transferred to the customer, decision rights must be allocated carefully (Richter et al., 2010) and it is crucial to define reliable outcome expectations that meet contractually agreed performance (Bonnemeier et al., 2010). Thus, there is a need for the company to manage new offering through the composition of specific and structured business deals/agreements that describe how rights and liabilities are distributed among the involved parties (Azarenko et al., 2009; Meier et al., 2010; Reim et al., 2015). Thus, complex contracts may be used to outline roles, procedures and penalties for non-compliance and determine outcomes/performances to be delivered by the PSS (Ng et al. 2013).	<ol style="list-style-type: none"> 1.What elements should be agreed upon with the customer and formalized in a written contract? 2.Is expertise for specialized external partners needed to write down contractual agreements?

Table 3 – PSS business model framework

Component	Variable	PSS business model
Value proposition	Value for the customer	It is generated by the reduction of initial investment and functional guarantee. Moreover, KINE becomes responsible for services during the whole life-cycle and this leads to the minimization of operational costs and risks for the customer to achieve an expected outcome.
	Creation of value	Value is created through the system's usage. Thus, value creation is interactional and the customer becomes a co-creator of value.
	Product ownership	KINE remains the owner of the system, while the customer pays a periodic fee for its usage.
	Service offering	New advanced services to be added to the offering, such as: remote monitoring and diagnostics, condition based maintenance, and also the taking over of the system's operations at the customer's by KINE, if requested by the customer.
Customers	Customer interactions	Maintaining customer relationships becomes a priority. Mindset needs to become more customer-oriented especially in the service function.
	Customers' information sharing	Key information to be shared with the customer concerns, e.g.: produced units, faults and maintenance activities, running hours, energy and material consumption.
	Customer and market insight	KINE is updated about customers preferences, problems and needs. In particular KINE acquires information on the production process, schedules, and system maintenance history.
	Target customers and segments	The PSS BM is addressing in particular customers operating in the logistics field (packing, palletizing, order picking, transport etc.). Other segments can be addressed with pilot cases.
Key Resources	ICT and monitoring technologies	New sensors and remote signals/diagnostics control are implemented to enable remote monitoring. Health management systems are used to monitor performance and usage conditions of the system. An ad-hoc information system is implemented to ease the information management process inside KINE.
	Installed base information	KINE collects and manage service-related data (e.g. maintenance activities), product and process related data (e.g. product usage, performance, ...) and data related to customers' use of the product. Such data allow monitoring the system (functionality and performance) and plan proactive interventions.
	Human	In order to set-up a new service orientation of human resources and corporate culture, new competences have been identified, for both service and sales personnel. Examples are: data processing and interpretation capability, execution risk assessment and mitigation capability, design-to-service capability, hybrid offering sales capability and hybrid offering deployment capability. Diagnostic capabilities are also needed for service technicians
	Financial	High financial capabilities are a prerequisite to cover the investments, in particular related to system building (material investment in form of loans or finance). Also new technologies and tools, personnel (people, training, knowledge upkeep), and marketing require adequate financial resources.
Key activities	Product development and design	The system should minimize the overall lifecycle cost, with the possibility to re-use elements. Thus, system modularization and "Design for X" techniques will be implemented.
	Services design and engineering	Service engineering activities allow to effectively and efficiently design a customized contract to address specific customer needs, and the related services. Moreover, new procedures and roles are needed to formalize the development of new service offering.

Component	Variable	PSS business model
	Offering configurations	Focusing on value-driven communication is crucial when the offering is complex. Sales and account managers have to work proactively with customers already before they send out a request for quotation. To support the sales force making the advantages for customers tangible, KINE developed specific sales tools based on the Total Cost of Ownership method.
	Products and services delivery	With remote diagnostics and product condition analysis the effectiveness and efficiency of (preventive) maintenance is improved, minimizing maintenance costs and maximizing the value generated by the product use.
	Intra-firm collaboration and integration	The collaboration among the company's personnel is formalized with specific procedures. Moreover, inter-functional periodic meetings are in place: all participants can submit in advance issues to be discussed. Follow-up minutes are shared within the company. Minutes would record actions, deadlines and responsibilities agreed, and any divergent opinion if required by a participant.
Key Partners	Partners network	Main partners in the new BM are: robot manufacturers, key subcontractors, sensor technology subcontractors, ICT systems integrators and finance partners. When selecting partners, their availability to adapt to the new revenue model should be considered.
	Suppliers relationship	The objective is to strengthen the relationships and focus on key suppliers. Bug fixing and field-testing are important tasks of integrators, and reporting to suppliers will be increased. Information is shared openly between the partners and customer information secured with the signature of non-disclosure agreements. Web-based applications to ease the exchange of information will be developed.
Channels	Sales channel configuration	Main sales channel is the same as in current BM (direct contacts). However, the salespersons need to devote more effort to explaining the value to the customer. Moreover, the direct interface with the end customer will facilitate the definition of selling parameters primarily driven by customer perceived value instead than internal cost.
	After sales channel / field service network	After-sales service personnel are mainly internal and highly integrated in every step of the product lifecycle with the sales-force. Field technicians will be specialized on specific customers/solutions.
Cost	Risk	The main risks are related to: customer conditions changes, service personnel changes, costs calculation estimations, customer interest on carrying on the contract (= showing benefits), predicting failures. These risks can be mitigated with contract length, and contract conditions (extra-fees for changing agree-settings).
	Cost structure composition and management	In a new 5-year contract, the cost structure can be estimated as follows: (1) System: initial costs of material, 25%; direct labour, 10%; subcontract, 5%. (2) Service: remote services, system user, maintenance, spare parts, modification, upgrades, ...: 50%. Indirect cost (sales and marketing, R&D, other fixed cost, ...): 15%.
Revenue	Revenue stream	Revenue streams consist of prepayment, payment at customer acceptance and periodic fee based on "pay-per-x" invoicing with a minimum contractually-set fee (to ensure that the system will not be left unused without any sort of invoicing).
	Contractual agreements	Invoicing and the invoice bases are agreed in contracts. Main parameters are as follow: - Monthly payments based on system usage, with e.g. system usage = Production time (or the time spent producing items). - Metrics for the service: MTTR and availability level.

Table 4 – KINE's new PSS business model configuration