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**"ENVIRONMENTALLY-FRIENDLY STRATEGIES IN MANUFACTURING
FIRMS THROUGH SERVICE-ORIENTED BUSINESS MODELS: A
QUALITATIVE INVESTIGATION"**

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Firma dello studente

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Introduction

In a world where around 90% of global population is breathing contaminated air¹, where plastic pollution is destroying natural habitats, and where overpopulation is causing overexploitation of resources (WWF, 2018), firms and business actors are asked to find replacements to the current linear economy model. In this context, manufacturing firms must be capable of developing and providing customers with alternatives. They must invest in continuous innovation and research in order to transform production and consumption to new models able to foster resource efficiency and reduce wastes and pollution deriving from business activities.

The development of new *Business Models* can contribute to reach these aims. Firms' way to answer to environmental issues is often associated with the implementation of *Product-Service System* models (later *PSSs*), that consists in business activities aimed at providing combinations of physical products and intangible services that aim at solving customer problems. The context of Italian manufacturing firms is currently experiencing this movement toward services. Although it is only at its beginning phase², the present study has the objective of examining whether this “*Servitization*” phenomenon provides a solution to environmental problems by conducting a qualitative investigation on two manufacturing companies that are currently developing or improving their service offerings.

Specifically, this work starts with the explanation of the concepts and implications of *Environmental Sustainability (ES)* and *Circular Economy (CE)*. Approaching this practice, requires the development of new *Business Models*, such as *Product-Service Systems*. In this sense, the second part of the first chapter is concerned with explaining *PSSs* and their environmentally sustainable consequences. After explaining the theory, the second chapter describes the use of notions and concepts derived from *Business Model Innovation*, *Sustainable Business Models*, *Circular Economy* and *Resource decoupling* in developing a framework for analysing whether the *PSSs* described in the case studies classify as *CE* strategies or, whether, at least they have a reduced negative effect on the environment. Finally in the third chapter, the case studies are described together with an initial contextualization of trends in the manufacturing industries derived from an interview with an industry expert. The results presented are discussed in the final conclusions of this work.

¹ Source: <https://www.who.int/news-room/detail/02-05-2018-9-out-of-10-people-worldwide-breathe-polluted-air-but-more-countries-are-taking-action> (Consulted on 04.02.2020)

² Source: <https://www.innovationpost.it/2019/11/14/dallafter-sales-al-customer-service-4-0-il-servizio-come-fattore-chiave-per-la-crescita-del-manifatturiero/>

1. Environmental Sustainability/Circular Economy and Product – Service Systems

The protection of the environment is a stringent concern of international institutions, governments and society in general. The aim of this chapter is to present and explain the concept and applications of *Environmental Sustainability* and *Circular Economy*. As the discussion goes on, it is important to establish strategies and pathways that allows firm to approach business activities in an environmentally sustainable way. In order to do so, Firms are asked to completely change their business model to a new one and academic literature identifies *Product-Service Systems* (later *PSSs*) as a *business model* for this purpose. Thus the last part of this chapter is dedicated to the presentation of this model.

1.1 Sustainability and Circular Economy

This section is concerned with explaining the notion of *Sustainability* and its three pillars (*economic, environmental and social*), which are considered different faces of the same principle. Following this, the importance of *sustainable business model innovation* will be examined together with the reasons why this work is focused only on the environmental perspective of *sustainability*. Finally, there will be a brief description of the notion of *Circular Economy* and its relationship with *sustainability*.

1.1.1 Sustainability: The Three Pillars

This concept places its roots back in the 17th and 18th centuries, when first discussed by forestry experts *John Evelyn* and *Hans Carl von Carlowitz*, who were concerned with *sustainability* in relation with the diminishing forest resources in Europe (*Purvis, Mao and Robinson, 2019*). In spite of this early concern, *Sustainability* emerged in the mainstream only in the 1980s when ecological and social criticism started to be threaded together with economic growth, with the aim of defining the notion of sustainable development.

The concept was introduced in the international policy debate in 1987, when the *UN World Commission on Environment and Development* published the report “*Our Common future*”, famously known as “*The Brundtland Report*” by the name of the chief of the UN Commission, who commissioned it. The goal of this report was to establish a long-term

environmental strategy aimed at achieving sustainable development and to lead to the achievement of mutually supportive objectives that interweaved relationship among people, resources, environment and development (*Our Common Future*, 1987).

As for the definition of *PSS*, there are many slightly different definition of *sustainability* and sustainable development: *Johnston et al.* (2007) assessed the existence of up to 300 definitions. The most commonly accepted one is given in the “*Brundtland report*” (*Purvis, Mao and Robinson*, 2019), where *sustainability* is addressed as “*the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs*”. In this definition, development is bound by the state of technology and social organization on environmental resources and by the biosphere capability to absorb the effects of human activities (*Our Common Future*, 1987).

A common approach to *sustainability* identifies it as a system of three interlinked pillars that must be balanced with each other: social, economic and environmental (*Doualle et al.*, 2015; *Purvis, Mao and Robinson*, 2019). These three perspectives are sometimes referred to as “*People, Profit, Planet*” and were implicit also in the *Brundtland Report* (*Purvis, Mao and Robinson*, 2019). They are often grouped together in the *Triple Bottom Line (TBL)*, which is a framework that appeared in the business literature in the late 1990s (*Elkington*, 1997) and is useful for balancing and measuring the performance of each of the three aspects (*Geissdoerfer et al.*, 2017).

The most common way used to visualize this three-perspective notion is depicted in *Figure 1*, which shows a typical representation of *sustainability* and its three pillars. Here, the pillars are seen as intersecting circles and *sustainability* is positioned in the centred intersection circle, meaning that it is created only by the simultaneous junction of all three dimensions.

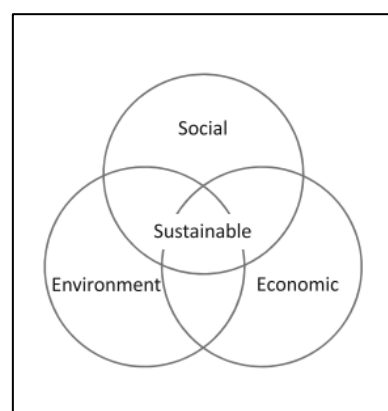


Figure 1. Typical representation of sustainability. Source: Purvis, Mao and Robinson (2019)

Sustainability is reached only when the performance of the three perspectives are considered simultaneously. Transposing this concept from the economic system to the business level, *sustainability* refers to the ability to satisfy stakeholders needs without compromising the ability of meeting their future needs (Hubbard, 2006).

The meaning of each singular perspective is explained in details below (Hubbard, 2006; Hu et al., 2012; Doualle et al., 2015).

- *Social perspective*: companies measure the effects they cause on their stakeholders with their operating activities, from product design to after-use disposal. The stakeholders considered in this dimension are both the one affected indirectly with business activities, such as local communities and society in general, and the ones directly linked to companies operations. The latter ones denote to the management of relationship with customers, employees, suppliers and business partners. The performance of this last pillar is the most difficult to measure because it refers to aspects such as fairness and justice, empowerment, employee and customer satisfaction, job opportunities and creation. These aspects are qualitative in nature, thus quantitative measures of social impact of product/services are difficult to calculate.
- *Economic perspective*: companies are producing products or services that satisfy customer needs at a profit. They are experiencing economic growth, appraised by increasing sales, revenues, profits and market share. Other measures of economic performance are *ROE*, *ROA*, *product/service price* and *added value*. For obvious reasons, without positive economic performance companies won't even consider producing a particular product or service. Thus, this aspect is absolutely necessary, regardless of the other two.
- *Environmental perspective*: companies takes into consideration the amount of inputs that are consumed while producing products/services and in a greater perspective, they look at all resources that are used during all lifecycle stages and the related by-products that are created. This dimension concerns with the misuse of energy, land, water but also with the level of waste, emissions and chemical residues that are produced. Furthermore, the environmental aspect includes also the type of materials used for products and their components, and the easiness of disassembly and recyclability. The importance of this pillar is rising due to global environmental challenges that the current society is facing.

1.1.2 Sustainable Business Model

The abovementioned *Brundtland Report* (1987) was aimed at setting up rules for responsible use of resources and sustainable economic development. The most remarkable ones are the following:

- the world population must develop consistently with the carrying capacity and productive potential of the ecosystem;
- ambient concentrations of pollutants in the environment and living creatures must not go beyond their absorption and regeneration capacity;
- consumption rate of renewable matter and energy must not exceed their given rate of reproduction;
- consumption rate of limited resources must be minimized by substituting exhaustible resources with renewable ones, by increasing material and energy efficiency and by recycling to an extent that is ecologically reasonable and economically justifiable;
- development and introduction of ecologically non-toxic, clean resources, advanced technologies and new products must be intensified.

These rules build up the concept of *ecological sustainability*, which is useful for understanding how to develop valuable legislation in order to cover the path for *sustainable development*. In spite of this, they completely lack practical applicability at the business level, as a consequences they cannot be easily converted into strategies for business management (Huber, 2000; Lüdeke- Freund, 2010).

*With this aim Lüdeke-Freund (2010) tried to fill this gap by intersecting the concept of *ecological sustainability* and business imperatives, and identified 3 *transformational strategies*, which are:

- *sufficiency*: practices aimed at changing consumption and production patterns by adopting a lifestyle that focuses on conservation of resources and nature;
- *efficiency*: activities that have the goal of reducing environmental damages per unit of output by improving technologies and organizations;
- *consistency*: actions concerning the development of a new technological paradigm with the objective of bringing industry in line with principles of nature.

The *business model* framework can be used for addressing these strategies aimed at bringing *sustainability* and *business concerns* at the same level, since it describes how corporate activities, resources and capabilities are shaped. Based on how they are designed, it can unfold the transformation potential needed to reach the goals set by the three strategies. Consequently, it became a useful tool in order to help companies visualizing how to improve competitiveness through an outstanding social and environmental performance (Lüdeke-Freund, 2010). According to this reasoning, a *business model* is sustainable when it creates competitive advantage by delivering superior customer value, while simultaneously contributing to the sustainable development of companies and society (Lüdeke-Freund, 2010). This framework is useful to incorporate the three pillars of the *TBL* into the firms' activities, purposes and performance measures.

The *business model* template becomes especially useful for creating innovative value proposition in order to support companies in competing successfully, while creating value for society and reducing the damages to the environment. The key to foster sustainability is to market successfully process or product innovations that allows companies to reach sustainable development goals (Lüdeke-Freund, 2010). But while it is easy for efficiency and quality improvements to translate into profits, it is not enough clear how social and environmental value might yield profit and competitive advantage for companies (Bocken et al., 2014).

The increased use of the *BM framework* for analysing companies' sustainable innovation and the increasing stream of research is the reason why the present work will adopt it to analyse *PSS* impact on *environmental sustainability*. Research in this topic has focused attention on some emerging and recurring themes such as technology advances able to drive *BM* innovation, the system perspective concerned with expanding boundaries that are needed to address global challenges, innovative approaches to cooperation with industry and non-industry partners and the need for education and awareness of the demand for *sustainability* (Bocken et al., 2014).

In order to build a *BM framework* that incorporates *sustainability*, some of its common elements should be reviewed in a different perspective, because *sustainable BMs* aim at delivering value to a wider number of stakeholders. Building on the models presented by Boons and Lüdeke-Freund (2013), Osterwalder and Pigneur (2010), Tunn et al. (2018) and Bocken et al. (2014), *BM* components are grouped into 3 main categories, which are summarized in *Table 1*.

These three main categories are hereby presented in detail.

Value Proposition

The value proposition should provide measurable environmental or social value jointly with economic profits. In practice, it should be concerned with offering value to customers in a way that balances the three *sustainability* pillars. Value proposition includes the customer components, both targeted segment and relationship management. In a sustainable perspective reaching customer acceptance in order to successfully replace less sustainable offerings is fundamental. Customers must be supported by companies to become more responsible in consume patterns. This is a challenge that is harder to overcome based on the type of targeted segment. In general, there is a trend highlighting that customer role is becoming more and more active, but not everyone is the same. Thus, companies must find a way to compensate them, especially the less active ones, for their “sacrifices”, so that behaving in a more sustainable way becomes more convenient for everyone (Tunn et al., 2018).

Value Creation and Delivery

By the means of the organization of *activities*, *resources* and *technologies*, companies exploit business opportunities with the aim of delivering value through *channels* to a high number of stakeholders, such as customers, industry affiliates, and suppliers, who should take responsibility without shifting their environmental and social burden (Boons and Lüdeke-Freund, 2013). This pool of stakeholders includes also different “unlikely” partners, such as NGOs and other non-industry allies that can provide different competences through informal arrangements or other alliances (Bocken et al., 2014). While firms explore the *sustainability* topic, they usually realize that developing a network is more important than ever. Partners and focal companies create together systems with the aim of developing new and disruptive pathways for value creation and delivery. Besides partnerships, another key component in sustainable BM is represented by resources, whose uncontrolled consumption is among the concerns presented at the beginning of this section. In particular, according to Tunn et al. (2018) the development of a proper resource strategy is essential. He identified the 4 following strategies for managing resources: *substitution of non-sustainable materials* with processes or materials coming from sustainable sources; *efficiency improvements to minimize the waste and negative impacts* through a drop in raw material use, waste per product and down-cycling of waste; *cycling of materials* through which materials taken from products at their end-of-life are reused as inputs for producing new ones; and *cycling of products and materials* which aims at re-using products or materials through second-hand sales, remanufacturing and refurbishing or take-back schemes.

Value Capture

This last category concerns with companies revenue schemes. It considers how companies decide to monetize and earn revenues for providing services and products to customers. *Revenue models* and *cost structures* construct the *financial model* component. The company should build a suitable distribution of economic costs and benefits among all the actors involved in the BM and should consider the firm's social and ecological impacts, too (*Boons and Lüdeke-Freund, 2013*). In particular, the revenue model is the most important. Companies need to find the appropriate way to monetize their offering and establish how consumers can obtain the desired functionality and who is responsible for providing it (*Manzini and Vezzoli, 2003*). *Tunn et al. (2018)* interviewed experts from industry, academia and policy, who suggested that revenue models for sustainable BM are related to *Tukker's classification of PSS (2004)*. The most anticipated trend is the reduction in consumer-owned products: there is an increasing attention toward models that provide products access or use instead of ownership. In addition, experts interviewed suggested the growing importance of value captured from the after-market, through monetization of schemes for extending products life with remanufacturing or second-hand sales. Specifically, *Tunn* identified 3 types of revenue models which are *product-oriented*, e.g. product related services or advices and multiple subsequent owners, *use-oriented*, e.g. renting, leasing, and other forms of subscription and *result-oriented*, e.g. pay per service unit and functional result.

Table 1. Sustainable Business Model Framework. Elaboration from *Bocken et al. (2014)*

<i>Value Proposition</i>	<i>Value Creation & Delivery</i>	<i>Value Capture</i>
<ul style="list-style-type: none"> • Products/services offerings providing measurable environmental and social value jointly with economic profits. • Customers segment identified both in customers willing to become more responsible or less active ones • Customer relationships become long-lasting, supportive, incentivizing 	<ul style="list-style-type: none"> • Technology that drives BM sustainable innovation, activities and channels • Partners such as customers, suppliers, industry and non-industry affiliates • Resources such as sustainable materials, waste minimization, cycling of materials and cycling of products 	<ul style="list-style-type: none"> • Cost structure • Revenue model such as product-oriented (product related services or advices and multiple subsequent owners), use-oriented (renting, leasing, subscription) and result-oriented (pay per service unit, functional result)

Sustainable business model innovation is about finding new ways of exploiting business opportunities and creating value for customers with the aim of approaching *sustainability*. It is about innovating through significant positive or highly reduced negative impacts for the environment and the society by implementing changes in the way companies and their

network create economic value or their value proposition to pursue sustainable challenges (Bocken et al., 2014). Companies need to tackle unsustainable practices by changing the core of doing business and the *business model framework* gives the right overall perspective by forcing to look at the whole picture.

In order to be successful, *sustainability* must be taken into consideration from the designing phase and companies must set highly ambitious goals, focused on maximising societal and environmental benefits, rather than economic gain only. Firms must take into account that introducing new *sustainable business model* may not be economically viable at the beginning but it may become fruitful in the future due to regulatory or other changes, such as variations in customer preferences or technological advancement. In this perspective of a fast-moving market, it may even become a way of being a step ahead from competitors.

1.1.3 Environmental Focus: Sustainability and Circular Economy

As previously explained, *sustainability* is composed of three pillars: social, environmental and economic. The present work will give more attention to two of these: the economic and the environmental perspective. This section will be focused on explaining the reasons why this choice was taken. In addition to this, there will be also an explanation of the concept of *Circular Economy* with the aim of using this model and its implications in the following chapters of this work.

While discussing the three pillars in the previous section, the economic one was deemed as fundamental. Companies won't even consider designing and implementing a different business model, let's say a more sustainable one, if it doesn't yield enough economic value, i.e. profits (Doualle et al., 2015). Increased economic growth for manufacturing companies is a necessary condition, regardless of the other two perspectives. The goal of a positive economic impact must always be satisfied, if a particular *BM* is to contribute to increasing positive environmental externalities.

Pieroni et al. (2019) found that increased economic results are one of the fundamental requirements for *BM* to contribute to *circular economy*, whose concept will be explained in the following part. It is crucial that new *BMs* ensure: an acceptable level of profit, which should be at least equal to the traditional *business model* earnings; an investment requirement able to guarantee a short payback period, in other word the break-even should occur in an

acceptable period of time for the company and the volume of returning products should be high enough to justify the required investments.

Indeed, it should be considered that the implementation of more *sustainable BMs* is mostly undertaken without real intentions of being *sustainable*. Most companies focus their actions on generating traditional product-related value (e.g. increased profits) without considering the environmental aspect, even though companies could cause unintended positive externalities for the environment, while try to gain higher profits they could cause (*Matschewsky, Kambanou and Sakao, 2018; Matschewsky, 2019*).

While economic growth is and has always been necessary for business development, the environmental issue is being discussed increasingly only since recent years. In fact, the growing attention toward global environmental issues is forcing companies to consider the environmental perspective while performing business activities. Environmental challenges are nowadays very stringent, and among these, one of the most discussed ones is the issue of global warming. Provided that the rate of increase remains the current one, human activities are causing temperatures to increase to levels, which are likely to reach 1.5°C between 2030 and 2052. With high confidence, such changes will cause an increase in temperature in land and ocean resulting in extremes hot weather in inhabited regions (*Masson-Delmotte et al., 2018*).

Another obstacle to future development is global resource scarcity. Overconsumption and overexploitation by global population are negatively impacting land, forests, oceans and freshwater reserves (*WWF, 2018*). This issue is forcing businesses to reduce the misuse of resources by finding alternative ways of accessing them or more drastically, by finding completely new types of inputs. Over the last 50 years, the *People's Ecological Footprint*³ has increased by about 190%, which means that human demand is consuming resources at a much faster rate than Earth regeneration possibilities (*WWF, 2018*) and the situation is worsening even more due to the rapid increase in global population. If human beings reach the number of 9.6 billion by 2050, the equivalent of almost three planets could be required to provide the natural resources needed to sustain current lifestyles.⁴

³ Measure of human consumption of natural resources.

⁴ Source: <https://www.un.org/sustainabledevelopment/sustainable-consumption-production/> (Consulted on 19.10.19)

Due to the stringent necessity of finding solutions for these environmental issues, research is giving always more and more attention to the impact that companies' activities have on the environment. The results of some studies mention that when firms consider their environmental footprints, they have more benefits from running businesses: from basic financial benefits, to green-specific ones such as resource savings and waste reduction. Moreover, they reach successfully marketing objectives such as improved corporate image, enhanced environmental awareness of customers and suppliers and also organizational structures and human resource can benefit from environmentally-friendly business practices (*Hu et al.*, 2012).

Finally, there is the social dimension perspective, which is the least explored. For this reason, *Hu et al.* (2012) studied the rankings of the various type of criteria for *sustainability*: while economic and environmental criteria were deemed respectively as highly valuable and significant, the social perspective has been proved to be the least important for firms. This aspect considers the management of relationships with different stakeholders, from customers, to employees, and to communities, that are affected by the activities of businesses. One interesting result of the abovementioned analysis shows that even though social dimension is the least considered, it should actually receive much more attention, being vital for successfully implementing sustainable business practices.

This perspective is the most difficult to access for a number of reasons (*Doualle et al.*, 2015). It concerns the quality of relationships, because it aims at evaluating how much producers are willing to cooperate with customers, employees, local communities and suppliers. Quantitative indicators for measuring such dimensions are difficult to calculate. Some authors tried to obtain social scores for criteria such as gender equality, health and safety, justice, and others even tried to use surveys along with quantitative indicators. Despite these attempts, the problem is that it remains still hard to find quality data for conducting assessments in this dimension.

The uncertainty and subjectivity of this aspect leads to a significant lack of quantitative assessment of the social impact of business actions. While there have been some attempts to translate social dimension into a quantitative one, there is still much to do in this direction (*Doualle et al.*, 2015). Indeed, on one hand, this lack of methodology calls for further research about this topic, which is certainly to be encouraged, on the other hand due to these same reasons this dimension is not analysed in this work.

As a consequence of the lack of quantitative measures for the social dimension and the increased focus on environmental challenges, the aim of the present research is to investigate environmental impact of innovative business practices⁵. This is performed by studying *innovative business models* able to eliminate or reduce resource depletion, pollution and wastes and to further endure sustainable development while maintaining economic growth. Deriving from the work of *Geissdoerfer et al. (2017)*, this kind of business models implicitly refer to practices and concepts inside the perimeter of the so-called *Circular Economy (CE)*, which, unlike *sustainability*, concerns primarily the economic systems with a focus on the environment, and results in only unintended or implicit gains for social dimension.

CE was defined first in 2013 by the *Ellen MacArthur Foundation*, which is a private US foundation, concerned with building a framework for a naturally restorative and regenerative economy with the cooperation with businesses, governments and universities⁶. A fundamental knowledge source for explaining *Circular Economy* is the report “*Toward the Circular Economy*” (2013), in which it is described as an economy in which present goods are re-used as inputs for future product forming a positive virtuous cycle. Specifically, this concept defines an industrial economy that is, by intention, restorative and has goals such as the use of renewable energy, the minimisation of waste and the elimination of toxic materials. *Figure 2* is an illustrative example of this type of economy.

In an economy like this, “waste” does not exist anymore. Indeed, in *Circular Economy models* the flow given by the sale of finished products is not maximized anymore and it loosed importance in favour of the valorisation of “stock” such as maintaining materials, components and products to their maximum utility and value⁷.

⁵ Precisely, the aim is to analyse the servitization in the manufacturing industry and whether the relative service strategies can classify as Circular Economy strategies, or whether they have an impact on the reduction of impact of business activities on the environment.

⁶ Source: <https://www.ellenmacarthurfoundation.org/> (Consulted on 7.11.2019)

⁷ Source: <https://www.industry4business.it/esperti-e-analisti/creare-valore-con-leconomia-circolare-opportunita-di-business-e-spinte-verso-la-sostenibilita/> (Consulted on 28.12.2019)

An emerging opinion in literature sees *business model circularity* as a precondition for sustainable manufacturing, which is then necessary for the augmented economic and environmental performance of businesses (Ellen MacArthur Foundation, 2012; Rashid *et al.*, 2013). *Circular Economy* is either a necessary element for fostering economic growth in the path toward a sustainable development, an archetype of sustainable business models (Bocken *et al.*, 2014) by being one of the possible ways to foster sustainable development or simply one of its encouraging strategies together with increased efficiency or dematerialisation (Geissdoerfer *et al.*, 2017).

This work will refer frequently both to the concept of *Sustainability*⁸ and of *Circular Economy*. Thus, it is important to clarify their meaning. Indeed, by examining in depth the relation between these two concepts, differences and similarities emerged (Geissdoerfer *et al.*, 2017). A brief presentation of these is presented in *Table 2*.

Table 2. Sustainability vs. Circular Economy: differences and similarities. Source: Own elaboration

	Circular Economy	Sustainability
Differences	Concerned with economic and environmental gains	Concerned with examining the triple aspects
	Emerged recently	Emerged in the 80s
	Focuses on efficient use of resources and less consumption and pollution, together with economic	Open-ended goals aimed at benefiting equally the three dimensions
	Implementation subordinate to geographical unit	Open-ended time dimension
	Priorities defined by government and companies	Priorities defined by all stakeholders
	Focus on financial advantages and reduced resource consumption and pollution	Alignment between different stakeholders
Similarities	Emphasis on intergenerational commitments as a direct consequence of environmental degradation	
	Increasing prominent role of international institutions	
	Exploitation of system design and innovation	
	Integrate development with non-strictly economic aspects	
	Diversified value creation	
	Favour cooperation and partnerships	
	Importance of regulation and relevant stakeholders	
	Technological advances as a driver	
	Business model innovation as a tool for implementation	

⁸ More precisely to the dimension of *Environmental Sustainability*.

First of all, their origins are different. While *Circular Economy* has emerged only since few years (Ellen MacArthur Foundation, 2012), *Sustainability* can be traced way back to 1987, the year in which the *Brundtland Report* was commissioned. But despite these different origins, they both emphasise the intra-and intergenerational commitments as a solution for the environmental degradation, calling for an increasing role of international institutions and a shared global perspective and emphasising problems of the whole planet that ask for global responsibilities and multiple agents coordination.

They have different goals, too. *Sustainability* has a more open-ended concern: it addresses a considerable and various multitudes of goals that can be adapted to different context and aspirations. On the contrary, *Circular Economy* is focused on the more efficient use of resource inputs and on the reduction of waste, pollution and toxic emissions, basically stressing economic and environmental gains compared to linear systems (Rashid et al., 2013). Their distinct objectives are reflected in different underlying motivations: *Sustainability* is based on past trajectories aimed at benefiting the three dimensions simultaneously, while *CE* is based on the idea that resources could be better used and pollution could be reduced through circularity, benefiting the economic actors that implement this system and could involuntarily positively impact the society.

Despite this, they appear as very similar approaches in the fact that they try to integrate non-economic aspects into development and often exploit system design and innovation in order to reach goals. Certainly, they both highlight the importance of diversification in the process of value creation, by describing more than the potential costs and risks of these business practices.

Yet, they present differences in timeframes required for the changes. *Sustainability* has an open-ended time dimension, since goals can be constantly adapted or reframed over time, while *CE* has a threshold within the geographical unit for successful implementation (Ellen MacArthur Foundation, 2012). Again, differences can be found also in the definition of activities. In the *Sustainability* approach, priorities are defined by all stakeholders and they share responsibilities which are not clearly defined. On the other hand, *CE* is focused more on the activities of governments and companies and the responsibility for reaching circularity in the system lies primarily with private business, regulators and policy makers.

These concepts are similar because they both strongly encourage cooperation between stakeholders: it should be an imperative element if firms are really intentioned to reach their goals. In order to do so, they equally rely on regulation and relevant stakeholders, who are

able to reach and control more resources and capabilities than any other possible actor. In addition, the implementation of such solutions, i.e. *Sustainability* and *Circular Economy*, is encouraged and fostered by technological advances in process inputs and production, which is also one of the above mentioned drivers of *PSSs business model*. In fact, incremental innovation through *business model variation* is often seen as the key pathway to the sociological and technical transition necessary to reduce the human impact on the environment and practice both *Circular Economy* and *Sustainability* (Geissdoerfer et al., 2017). Nevertheless, drivers of the two are very similar to each other, while priorities are very different: *Sustainability* is about interest alignment between different and relevant stakeholders, whereas *CE* highlights the importance for companies of reaching a financial advantage while at the same time reducing resource consumption and pollution for the environment.

Consistently with the comparison of the two notions and the exclusion of the social dimension of sustainability from this work, *Circular Economy* and *Sustainability* are hereby treated as much similar concepts. Specifically, *Circular Economy* is used as a mean to measure the environmental gains of innovative and potentially sustainable *business models* such a *PSS*, which was presented in the first part of this chapter.

1.2 Services in the manufacturing industry: Product-Service Systems

Innovative manufacturing firms are increasingly concerned about finding new ways to compete strategically: they are constantly trying to develop unconventional and original business models that allow them to differentiate from competitors. In this context, selling high performing machines is not enough anymore; firms must enlarge their core business from pure machine production to assistance services provision, especially in a global reality, where customers are dislocated all over the world⁹. Thus, delivering additional services is becoming more and more significant as a mean to build a distinctive competitive advantage (Spring and Araujo, 2009).

In academic literature, this phenomenon is identified as “*Servitization of manufacturing*” (or only *Servitization*) (Lightfoot, Baines and Smart, 2013). The term “*Servitization*” highlights the shift toward the provision of intangible solutions, that support or complement the physical

⁹Source: <https://www.innovationpost.it/2019/11/14/dallaafter-sales-al-customer-service-4-0-il-servizio-come-fattore-chiave-per-la-crescita-del-manifatturiero/> (Consulted on 26.12.2019)

product itself (Neely, Benedettini and Visnjic, 2014). This is an on-going process in the manufacturing industry and it is specifically true for companies that are offering very complex goods.

Currently, the “*Servitization of manufacturing*” is being studied from different academic communities (Lightfoot, Baines and Smart, 2013). Indeed, research in this field can be grouped into five main communities:

- *Service Marketing*: marketing practices are changing because of the move from typical transactional relationships with customers to more long lasting and relational ones. The attention is given primarily to the customer relationship management in the provision of services and the origins of this string of research are identified in the acknowledgement that products and services are often inseparable and the relationship created between firms and customers lead to the possibility of long term provision of services.
- *Service Management*: is concerned with topics such as the management of operations and strategy in providing services (i.e. service classification, positioning and delivery) and more recently, it focuses on the study of the differences between in service organisations and product-focused divisions, especially concerning their dissimilar organizational culture.
- *Operations Management*: the research community focused on giving emphasis to the various strategies for delivering products and services combinations. More recently, it is exploring the concept of customer-centric business models aimed at providing customers with their “desired outcomes”.
- *Service Science*: the study of complex service systems and the process of co-creation, through a merge between technological knowledge and business processes. This research community is developing really fast and it focuses on examining the system of interactions between people, technology and businesses.
- *Product-service systems*: the stream of research that had its origins in the ecological and environmental tradition. They are considered a solution for problems such as environmental pollution and degradation, because they have a potential for decoupling environmental pressure from economic growth, by focusing on product use, rather than asset ownership (Tukker, 2004; Lightfoot, Baines and Smart, 2013).

Due to their potential in reducing the environmental problems, the present work will be drawing knowledge and concepts from this last stream of academic research: the *Product-service systems*.

According to Khan et al. (2019), PSS are a special case of servitization. *Servitization* and *PSSs* describe the same notion, but while the first entails only the economic and management context, the latter takes into account also the *sustainability* perspective. As above mentioned, the notion of *PSS* was identified by a Scandinavian research community that aimed at studying the potential correlation between the increasing development of product-service combinations as market offerings and the notion of economic, social and environmental *sustainability* (Lightfoot, Baines and Smart, 2013).

In the literature, the term *Product-Service System* was coined for the first time in the report written by Goedkoop et al. in 1999 (Haase, Pigosso and McAloone, 2017), in which it was used for identifying a “*marketable set of products and services capable of jointly fulfilling a user’s need*”. Since the first introduction of this concept, research on this topic has been growing, even though a common definition of *PSS* has not yet been decided. In order to fill this gap, a number of literature reviews were published with the aim of finding a reasonable pattern in the various descriptions of this innovative business model through the means of determining the shared and repeated elements in all of them.

The article of Haase et al. (2017) relates to this issue and states that the most referenced definition in academic literature is the one by Mont (2002), that describes *PSSs* as “*a system of products, services, supporting networks and infrastructure that is designed to be: competitive, satisfy customer needs and have a lower impact than tradition business models*”. Together with this definition, another fundamental and often referenced one is given by Tukker and Tischner (2006), according to whom *PSSs* are a “*specific type of value proposition that a business (network) offers to (or co-produces with) its clients*”.

In the three definitions stated above there are some elements that are recurring such as the “*combination of tangible and intangible features*” and the “*ability to fulfil customer needs*”. In a study by Haase et al. (2017), they examined 59 papers about *PSS* and found specifically that the “*most common appearing PSS characteristics*” in literature were, as mentioned earlier, the “*product & services*” mix and the goal of “*customer needs*” satisfaction. Drawing from this, a *PSS* can be generically defined as a combination of tangible products and intangible services aimed at satisfying a specific need, by delivering a solution to customers, in order to solve a problem for them.

Moving on from this issue of finding a common definition for *PSSs*, there is a need to identify some typical features of this *Business Model*. In order to do so, *Mont* (2002) tried to develop a list of the main *PSS* elements, with the aim of defining its characteristics. According to his article, the predominant elements in this kind of offerings are:

- the object is the offering is a combination of products and services, and in the most extreme cases there could be even a substitution of products by services;
- the concept of product's use becomes different;
- services are sold by companies at the sales point, together with products;
- the offering provided by firms consists of maintenance and upgrading services and of revalorisation, such as re-use or take back services.

Furthermore, there is a need for changes while implementing a *PSS* (*Mont*, 2002). Indeed, in most cases, this new *business model* requires: *producers* to change their traditional role to one that requires a higher responsibility throughout the whole product lifecycle; *consumers* to be more proactive and more involved and trained by manufacturing companies; *organisational structures of companies* to be arranged in a way that fosters greater customer cooperation; and finally, *design methodology of companies* to take into account the need for a closer integration among all actors and stakeholders within the lifecycle of a product.

1.2.1 Product-Service Systems: drivers for implementation

The development of integrated product-services combination offerings is incentivized by drivers that are various and vary in nature. For example, *Goedkoop et al.* (1999) identified some “*eco-drivers*” as a reason for their first introduction. These are factors such as: environmental legislation; customer pressure for solving environmental problems; and institutional agreements for reaching a particular level of green purchasing. These are strictly related to the environment, but there are others that are typical of marketing studies such as the possibility of enhanced brand image, differentiation from competitors and development of a long-lasting competitive advantage. Hereafter, drivers are grouped according to their

different nature and reasoning into 5 main categories¹⁰, which are *environmental, economic, strategic, technological, legal* (Neely, 2009; Avlonitis et al., 2014).

Environmental

As already mentioned, the concept of *PSSs* was born originally with an *environmental rationale* (Goedkoop et al. 1999). Thus, from a strictly theoretical point of view, this is the first significant group of drivers which lead to the development of these types of business models. Societies, governments and international institutions are looking for new ways of doing business due to the increasing attention toward resource scarcity, which is a global problem of growing importance (Avlonitis et al., 2014). The diffusion of the implementation of such business models may provide a solution to the issue of facing economic growth in an environmentally sustainable way.

Indeed, through *PSS Business Models (BMs)* both providers and customers are incentivized to act in a way that minimizes their impact on the environment. For companies, an improved environmental performance leads to positive return in terms of enhanced competitiveness. But it requires fundamental changes in the way in which manufacturing firms create and deliver value to customers (i.e. their *Business Model*) and besides this, through *PSSs* there are incentives to create products that last longer and can be re-used at the end of their lifecycle (LC). On the opposite, from the customers point of view, *PSSs* could provide a practical way to reduce their environmental footprint even though they must revise their idea of ownership: while customers value a lot “owning a product”, using rather than owning is potentially much more environmentally friendly (Mont, 2002; Neely, 2009; Avlonitis et al., 2014). This lead to the problem that business models that favour use over ownership may create issues for the market acceptance of *PSSs*. In order to overcome this issue, the present study focuses on the manufacturing industry¹¹, in which the value of ownership should be less relevant than in *Business to Consumers (B2C)* industry, thus reducing the risk of losing appeal for the customer (Tukker, 2015).

Economic

The second group of drivers is associated with an *economic rationale*. To begin with, service’s implementation through the development of a *PSS* offer represents a move on the axe of differentiation for companies, which is often required for firm’s survival because of the

¹⁰ Source: <http://andyneely.blogspot.com/2013/03/service-as-pre-sale-opportunity.html> (Consulted on 30.12.2019)

¹¹ In particular, the focus is on the Business to Business industry (later B2B)

increasing commoditization phenomenon and the fierce rivalry on costs, due to the unfair competition coming from low cost countries (Neely, 2009; Avlonitis et al., 2014).

Another key economic driver is a consequence of the high number of products sold and in use by manufacturing firms, i.e. their *installed bases (IB)*¹². Indeed, when the number of new products sold is excessively smaller than the one of already installed products (i.e. *installed base*), companies are motivated to capture additional profit margins on value-added services (Kowalkowski and Ulaga, 2017). Thus if markets are already saturated, there is an incentive to extend product life cycles, and consequently gather new value by offering life cycle support and additional services (Neely, 2009).

Services have potentially much higher margins: according to a cross-industry study, margins in services are from two to five times higher than margins in the product business (Gebauer, Krempl and Fleisch, 2008; Kowalkowski and Ulaga, 2017). In addition, since services, such as maintenance ones, often follow a recurring pattern they represent a much more stable source of revenues for firms, than physical products, which are sold with one-shot sales transactions. Finally, in terms of managing risk for customers, from their perspective, PSSs offer them a way of reducing risk by decreasing or at least stabilising maintenance costs, through supplier support and increased predictability (Neely, 2009).

Strategic

From a *strategic perspective*, the shift toward offering product/service bundles is driven by customer demand for high quality and value-added offerings, the phenomenon of mass customization and the request for a higher product variety flexibility (Mont, 2002). Services enable a more effective differentiation advantage that lead to retaining existing customer and attracting new ones. Besides this, by providing a customized service, competitors are locked out, because imitation becomes much more difficult, leading not only to the creation of a competitive advantage, but also to the development of a sustainable one.

Moreover, services augmented offerings facilitate sales by establishing a high quality brands reputation and by enabling the creation of a qualitative, long-lasting relationship between supplier and customer. As a consequence, PSS are incentivized by the possible lock-in effect for customers: by providing personalised maintenance services and original spare parts, a

¹² Quantity of goods that have already been sold and are currently in use. Source: Kowalkowski and Ulaga (2017).

manufacturing company offers a service that is rare and unique for the customer, thus eliminating the risk of substitution by competitors.

Technological

The fourth group of drivers concerns the fast *technological* development. Advances in ICT and information processing technology enable companies to provide remote and qualitative lifecycle services that are opening up new opportunities for manufacturers. For example, the use of I.o.T. and sensors permits companies to perform remote monitoring and pro-active maintenance of machines, simplifying their use for customers (Avlonitis et al., 2014). In addition, information processing technologies allow manufacturing firms to collect an extensive number of data with the aim of performing big data analytics, which are extremely helpful in increasing process efficiency and reducing wastes.

Legal

From a *legal perspective*, companies are facing an increasing number of threats that comes from the development of new and always more stringent regulation. This is a trend that is particularly true in the European Context and since the present study is analysing case studies and trends in the Italian manufacturing industry, a presentation of this legislation is appropriate.

Companies must comply with regulation such as the one about *E.P.R.*, otherwise known as *Extended Producer Responsibility* (Mont, 2002), which is an environmental policy approach that extends producer responsibility for a product till the post-consume stage of its lifecycle. The relevant implication is that the producer becomes economically and physically responsible for after-use disposal, thus incentivizing or even forcing environmental consideration since the product design stage¹³, leading to the development of offerings that are comprehensive of End-of-Life management services. At the EU level, *E.P.R.* is present in three Directives: the *ELV Directive 2000/53/EC*, the new *WEEE Directive 2012/19/EU* and the *Batteries Directive 2006/66/EC* and it is used as a major tool to promote resource-efficiency and responsible waste management (Monier et al., 2014).

Beside *E.P.R.*, there are many other legislative threats. Another one is the *Integrated Product Policy*: a policy that is aimed at trying to reduce the environmental degradation caused by products, whether through their manufacturing, use or final disposal. The rationale behind this

¹³ OECD definition. Source: <http://www.oecd.org/environment/waste/extended-producer-responsibility.htm>

legislation is that product life-cycle is enduring and complicated and it involves many different activities, from design to after-use disposal, and many actors, from product designer to customers, thus it is important to incentivize all parts in the various phases of the LC to improve their environmental performance.¹⁴

Other than the above mentioned legislation, authorities, especially in Europe, are trying to influence the traditional way of doing business of companies with other related policies regarding waste, water sustainable use of resources and sustainable consumption of products, chemicals, and other environmental programs.

1.2.2 Product-Service Systems Business Model analysis

The journey toward a so-called *service infusion* in the product offerings is very often associated with a change in the business model (Mont, 2002; Tukker, 2004; Lightfoot, Baines and Smart, 2013). As a consequence, the *business model (BM)* framework is a useful way to analyse the implementation of *PSSs*. There are two main reasons underlying the use of *BM* framework in *PSS* analysis (Adrodegari and Saccani, 2017):

- the implementation of *PSS* is multidisciplinary by nature and the business model approach is particularly adequate because it helps understanding how firms can fit strategic, operational and economic decisions in order to offer product/service solutions;
- the *BM* approach provides frameworks such as the *Canvas* (Osterwalder & Pigneur, 2010) that has a high level of consensus and diffusion in the managerial and academic communities and could help in building the common and practice-oriented language, that is lacking in the *Servitization* research.

In the literature, many slightly different frameworks are described. The *BM Canvas* described for the first time by Osterwalder & Pigneur (2010) is the most accepted model. It groups 9 main components, such as the following:

- *value proposition*: it is the subject of the offer and answers to the “what” question. Basically, it comprehend the bundle of products or services that can solve a customer problem or satisfy a specific need;
- *customer segment*: it represents the type of customers, that is targeted by the organization.

¹⁴ EU definition. Source: <https://ec.europa.eu/environment/ipp/>

A firm can target more than one;

- *customer relationship*: it identifies the type of relationship (e.g. personal, long-lasting, contractual, transactional), which is established with each customer segment. Different customer segments may entail different type of relationships;
- *channels*: channels in a *BM Canvas* identify how companies reach customers. This component consists of the communication, distribution and sales channels for delivering the value proposition;
- *revenue stream*: it summarizes the mean used by firms for gathering or capturing value from customers. In other words, it represents the pricing mechanisms that generate revenues for the company;
- *key resources*: they entails all the assets and inputs that are needed in order to offer and deliver the bundle of product/services;
- *key activities*: they are all the actions performed with the aim of offering and delivering the bundle of product/services;
- *key partnerships*: they represent all the actors involved in the creation and production of the value proposition. In other words, it is the network of suppliers and partners that make the *BM* operative;
- *cost structure*: it sums up all the costs incurred by the company in making the *BM* work.

The use of these components in the *PSS* analysis allows to reach a level of formalisation that helps to understand the way in which manufacturing companies provide and create value for customers. Furthermore, it is a tool able to identify and fill in the gaps regarding the relevant elements for moving to an innovative *PSS* configuration (Adrodegari et al., 2017).

Due to the reasons previously presented, various *business models* were developed in order to analyse the implementation of *PSSs business models*. For example, Reim et al. (2017) examined case studies and identified activities that correspond overall to the dimensions of firm's creation, delivery and capture of value. Specifically, these are summarized in the *Table 3*. This study aims at understanding how the transformation of *business model components*, toward more servitized ones, enables organizations to develop activities that are more environmentally sustainable. The model created by Reim et al.(2017) is aimed exactly at developing this analysis.

Table 3. Summary of business model activities for implementing PSSs. Source: Elaboration from Reim et al. (2017)

<i>Value Creation</i>	<i>Value Delivery</i>	<i>Value Capture</i>
<ul style="list-style-type: none"> • Taking over responsibilities that were previously handled by customers by providing lifecycle solutions or taking over operational activities from customers • Resources utilization by increasing asset utilization, streamlining make or buy decision, minimizing product downtime • Interaction with customers by developing knowledge of customer's processes, predictive capabilities of customers' requirements, by involving customers in the design and development of the offering 	<ul style="list-style-type: none"> • External distribution network by identifying the skills needed to be enhances, forging new delivery partnerships, localization of support services, developing of digital interface/platforms • Establishing new routines by orchestrating skills across business units, cross regional interactions, and by managing the complexity of PSS provisions 	<ul style="list-style-type: none"> • Manage risks by managing the risk of adverse market selection (having PSS higher benefits when asset failure is high) and by managing the operational risks effectively • Developing new revenue models such as valued-based pricing model, profit-sharing revenue model and pay-as-you use revenue model

Besides this model, there are others that have been developed in the literature. In particular, *Adrodegari and Saccani (2017)* conceived a version of the *BM framework*, which is modelled for examining service transformation concept in the literature. It displays the most typical *BM* components in the literature (*Wirtz et al., 2016*), but some changes were made to the model of *Osterwalder and Pigneur (2010)* in order to analyse the specific phenomenon of Servitization. The canvas was transformed with the aim of presenting the most relevant components for servitization. The framework is depicted in *Table 4*.

This model is apparently quite different from the one by *Reim et al. (2017)*, which is much more specific in the activities identified. Despite this, in a detailed analysis they appear similar in their components: both models value customers' interactions, the development of revenue models, the utilization of resources and the importance of establishing a valuable network. For the scope of this work, the latter framework presented by *Adrodegari and Saccani (2017)* results to be more useful, because by having been developed through literature it is more neutral and easier to adapt to the case studies presented in the following chapters.

As a consequence in the analysis of qualitative case studies, the investigation of the

components will draw notions mainly by this latter model. Even though, some of the activities identified by *Reim et al. (2017)* will be useful for the second case study.

Table 4. *BMs for service transformation. Reworked version from Adrodegari and Saccani (2017)*

Strategy: plan of action to reach a goal			
Finances: costs incurred to make BM operative	Value Proposition (Market offering): benefit or value delivered to the customer through the bundle of products/services		Revenue Model: methods for extracting value/profit from the customers
Resources: internal and external assets (human, information, ICT and financial) for value creation and delivery	Service provision (key activities): most important actions for delivering value	Customer: type of relations, customer segment as well as definition of their role as a user	Network: partners, suppliers and relative activities acquired from them by the company

Thus, this framework appears to be very useful in this context, even though its practical application is still an emergent research topic (*Adrodegari and Saccani, 2017*). But for the abovementioned reasons and the scope of the present work, in the following sections it will be exploited in order to examine the trends in *PSSs* delivered by companies, through the use of case studies, and to explore its potential application to *Circular Economy* and *environmental sustainability*.

1.2.3 Product-Service Systems: Models and Strategies

This section will explain the differences among the types of *PSSs* and the different strategies that are commonly implemented by companies operating with this type of *BM*.

As explained in *section 1.2*, *Product-Service systems* have overall common features, but they differ in the extent to which their value is determined by the service or by the product component (*Tukker, 2015*). According to this extent, they are categorised into different types and it is important to note that each type varies extensively in its *sustainability* potential compared to the others (*Tukker and Tischner, 2006*). Indeed, the literature has largely agreed on distinguishing them into three main groups based on the size of the service component as shown in *Figure 3*.

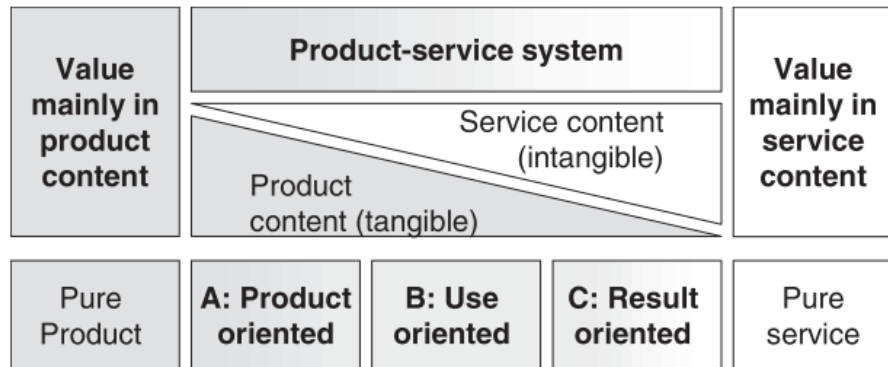


Figure 3. Categories of PSS. Source: Tukker, 2004, p. 248

They are classified as *Product-oriented*, *Use-oriented* and *Result-oriented* (Tukker, 2004) and the difference among them are the following:

- *Product-oriented* are the first and most diffused type of PSSs. This business model is mainly focused on selling physical products. Here, the ownership is always transferred to the customer and they are characterized by the fact that manufacturing companies add to the physical tangible offering some extra services related to the product such as installation or implementation services, maintenance and support services or consulting services (Tukker, 2004; Neely, 2009). Other typical services are improved maintenance and/or services that increase product/material recycling (Tukker and Tischner, 2006).
- In *Use-oriented services*, the service component is higher than in the first type. Product is still central in the offering, but the *business model* is about selling its use. The provider keeps the ownership, thus the product is available to the customer in a different form (e.g. shared use, product renting, product pooling or leasing) (Tukker, 2004). This *BM* involves a coupled product and service, and the focus is mainly on the service component. The use of the product is intensified in this strategy (Tukker and Tischner, 2006; Neely, 2009).
- *Result-oriented services* entail the third and most difficult to implement category. These services are the ones that are oriented toward need-fulfilling (Tukker and Tischner, 2006); the supplier and the customer agree on a specific result without a pre-determined product involved. Some examples of this *BM* are the following: *activity management*, through which companies outsource an activity to a third partner that uses performance indicators to measure the quality of the service; *pay per service unit*, when the customer pays the output based on the level of use; and *functional result*, where supplier and customers agree on a result, that the provider can freely decide how to deliver it (Tukker, 2004).

The different *BM*s types were identified based on the service component characteristic. The greater the service component, the higher the potential for *sustainability*. Moving deeper into the notion of *sustainability*, which will be the focus of the next section, the literature review of *Kjaer et al. (2018)* identified and grouped different strategies that can be performed by firms, approaching this new way of creating value for the customers and aiming at conducting business in a more sustainable way. They can be performed in all the three previously identified servitization business models, even though some are used more often for a specific one, because of some feature of the various strategies.

They were identified by the means of a literature review and they are a summary of the main *PSS*s approaches that are typically implemented by manufacturing companies. More precisely *Kjaer et al. (2018)* grouped them into the 5 main following strategies categories:

- *Operational support*: the supplier offers to the customer services for sustaining its products operations by monitoring their performance and/or training personnel in order to maximize the use of the product.
- *Product maintenance*: the provider offers maintenance, repair, or upgrade services during the use stage of the product. This strategy is used very frequently in product-oriented business models. It is usually the first step taken by companies that start to endure a service transformation.
- *Product take-back or End – of – Life Management*: the provider is in charge of End-of-Life phase of the product and decides about their reuse and remanufacture at product, component or materials level. This strategies are aimed at creating value from waste and are typical of closed loop *business models* (*Bocken et al., 2014*).
- *Product sharing*: the ownership is maintained by the provider but the resources are shared among users. Some examples are product rental, short term schemes, or leasing, and, in general, all strategies that consist in the product use being leased on a long-term basis (*Bartolomeo et al., 2003*). This scheme is typical of use-oriented services and its most common application is in *B2C* sectors (e.g. car-sharing).
- *Optimized result*: the provider dematerializes the offering by delivering to the customer a functional result, such as a specific level of performance of a machine. This last strategy is typically performed in *Result-Oriented BM*s.

These strategies' classification is presented because it will be used in the third chapter of the present work that is aimed at determining the environmentally sustainable potential of *Product-Service Systems* through the investigation of case studies. In particular, these strategies are relevant with the aim of analysing the “*Service Provision*” component of the *business model* framework for *Service Transformation* (Adrodegari and Saccani, 2017), which was discussed in *section 1.2.2*. As it is described in the next chapter, these strategies are presented with the aim of understanding the *resource decoupling* potential of the implementation of *PSSs* activities. This is possible because the model presented by *Kjaer et al.* (2018) has been developed with the aim of determining whether service strategies can classify as *Circular Economy strategies: PSS* strategies entails enablers' features that describe the *relative resource decoupling* potential of *service activities* in the manufacturing industry. This model can be exploited to verify whether they classify as *CE strategies*, but also to understand whether *PSSs* entails some positive effect on the environment even if they does not classify entirely as *CE*.

2. Environmentally sustainable Product – Service Systems

Business Model

The aim of this chapter is to present first of all the concept of *Business Model Innovation (BMI)*, because it is relevant in approaching *Environmental Sustainability*. Then, drawing from this first section, the others are concerned with discussing the framework that has been used to analyse the two qualitative case studies and with explaining the methodology implemented to classify and code the concepts from the case study research that has been conducted.

2.1 A Business Model framework for environmentally sustainable PSSs

In the previous chapter, there were many references to the use of a *Business Model framework*, because literature and academic researchers present it as useful in analysing the way and the processes used by companies that aim at creating, delivering and capturing value to and from their targeted customers.

The aim of this work is to study how the development of different and innovative *business models* in the manufacturing industry can be achieved in a way that is not only economically successful, but also environmentally sustainable. In order to do so, two case studies will be presented in detail in the following chapter. They have been analysed through the use of a *BM framework* that has been developed by examining of the literature that concerns with *Business Model Innovation (Chesbrough, 2010; Teece, 2010; Baden-Fuller and Mangematin, 2013), Sustainable Business Models (Bocken et al., 2014; Reim et al., 2017; Tunn et al., 2018)*, in particularly the models of *Circular Economy and PSSs (Lindahl, Sundin and Sakao, 2014; Tukker, 2015; Kjaer et al., 2018; Matschewsky, 2019)*, and *Business Models for service transformation (Reim, Parida and Örtqvist, 2015; Adrodegari and Saccani, 2017; Reim et al., 2017)*. The goal is to develop a framework for case studies investigation that is able to highlight the relevant components in each specific case.

For these reasons, the first section of this chapter is dedicated to the explanation of *BMs*. The goal is to establish the foundations for its use in this work by describing firstly the concept underlying “*Business Model framework*”, secondly the importance of *Business Model Innovation* and finally the use of its elements in the analysis of the case studies.

2.1.1 An introduction to Business Model concepts

The *Business Model* is useful in order to describe the logic according to which companies create, deliver, and capture value from customers: it summarizes the financial and organizational architecture of a business (Teece, 2010). In particular, it is able to capture the firm's behaviour in the industry context by remarkably describing its characteristics and activities in order to recognise the reasons of its success, that can be identified in some specific elements or in an original combination of them (Baden-Fuller and Morgan, 2010).

They are expected to fulfil different functions based on their components and structures. Indeed, by examining at the models presented in the previous chapter and the elements that were identified as relevant, a *Business Model* can be used to (Chesbrough, 2002, 2010):

- identify the value created for customers by analysing the offering, the targeted market segment and the competitive strategy through which the company plans to gain competitive advantage;
- describe the value capture mechanism, i.e. the revenue mechanism, the cost structure and the relative profit potential;
- detect the network linking suppliers and customers aimed at delivering the value created by the product/service offering.

Essentially, *Business models* allow firms to structure their value creation and have a clear view of how they are achieving their results. In academic research and especially in the context of innovation management, they are presented a tools able to fulfil functions such as: the *categorization* of businesses and *investigation* of business models conception (Baden-Fuller and Morgan, 2010; Baden-Fuller and Mangematin, 2013).

In particular, when used for achieving the first purpose¹⁵, *Business Models* are employed as standard exemplifications for successful combinations of business elements. They serve as tools able to classify businesses into specific categories and then explore the nature of these categories. In this process, researchers exploit this framework for describing how companies operate generically and then, categorize them according to which kind of *Business Model* they employ. In management research, the categories identified in this way, i.e. through the study of real-life example, are considered Exemplar *Case Business Models*.

¹⁵ Categorization

The latter function¹⁶ refers to the use of the *BM framework* for inquiry objectives. Given the exploratory nature of this study, this second meaning is the reason why it has been used in the present work: it allows to explore "cause and effect" relationships in order to understand the elements, that act as opportunities, and the factors, which act as barriers, in companies that are trying to develop new *environmentally sustainable business models*. Fundamentally, it enables the identification of elements on which the firm should focus attention to, and thus, gather insights on how companies innovate their *business models* in order to adapt to technological development, environmental challenges or market changes (*Baden-Fuller and Morgan, 2010*). To this purpose, just like normal economic models, *BM*s can be modified and manipulated allowing researchers to investigate specific elements or domains. This way, they are seen as useful tools that can generate concepts or theories or that can be used to better appreciate phenomenon that are currently developing in the industry, such as the previously mentioned *Service Transformation*.

In particular, in the context of becoming more *environmentally sustainable* or practicing *Circular Economy*, the exploitation of the *Business Model framework* is relevant because in order to develop such an offering companies must act upon their way of creating, delivering and capturing value for customers (*Bressanelli, 2018*). *Circular Economy* and *Servitization* are opportunities for companies, proven that they are able to re-organize and re-think the way in which they offer their value propositions to customers. Essentially, they must move from sales of physical products and develop service-based offerings, through which they are incentivized to design longer-lasting products, which are easily decomposable and re-usable¹⁷.

If companies are oriented to that, changing their value propositions is not enough, they must transform their whole *Business Models* and the activities related to that (*Ellen MacArthur Foundation, 2012; Dimache and Roche, 2013; Adrodegari and Saccani, 2017; Bressanelli, 2018*). Thus, since the following case studies are operating in this context, they are investigated through the perspective of the *BM framework*. In addition, the need for designing new *Business Models* in order to reach the objective of becoming more environmentally sustainable, highlights the logic according to which *Business Model Innovation* is essential in this perspective and explains the reasons why the following chapter presents the relevant elements and activities of *Business Model Innovation*.

¹⁶ Investigation

¹⁷ Source: <https://www.industry4business.it/esperti-e-analisti/creare-valore-con-leconomia-circolare-opportunita-di-business-e-spinte-verso-la-sostenibilita/> (Consulted on 30.12.2019)

2.1.2 Business Model Innovation: Relevant Activities

Constructing new *Business Models* is considered fundamental for fostering innovation of any kind (e.g. technological, sustainable, environmental, etc.). Despite this, the process of modifying the way in which companies create, deliver and capture value for their targeted customers is very complex, even when the aim is only to adjust or improve it. The main difficulty can be identified in the fact that a *Business Model* provides information related to different disciplines, since it maps both economic indicators, such as value, price, and profits, and technical measures such as feasibility and performance (Chesbrough, 2002). Thus, handling this kind of transformations requires a multidisciplinary approach.

In particular, in *Business Model Innovation*, there is the need to keep an overview of different factors related to companies' actions and performances, while being able to analyse in deep the most important ones. Entrepreneurs and managers should be careful in handling their development: they are not always successful receipts; instead they are likely to be highly case-dependent. Their design involves an iterative and repetitive process capable of identifying what works and what doesn't. Indeed, constructing a *Business Model* with the sure purpose of being successful is not easy: in order to do so, the firm must achieve a competitive advantage, by the development of business architecture, whose logics and trajectories are hard to imitate and sufficiently differentiated (Teece, 2010). And, to the purpose of developing a *servitized business model*, this becomes easier because delivering services allows companies to develop a personal and customized relationship with customers that install loyalty and commitment, and makes it harder for competitors to replicate the incumbents' ways of operating (Čater and Čater, 2010).

On the other hand, in the context of achieving environmentally sustainable goals, such as sustainable industrialization fostered by technological progress and sustainable production and consumption¹⁸, there is a growing recognition that *Business Model Innovation* is increasingly recognised as essential in order to deliver greater environmental sustainability in the industrial system (Lüdeke-Freund, 2010; Bocken et al., 2014). Even if, it is quite difficult to recognize precise and detailed steps in order to foster *sustainable Business Models* implementation and also, the options available for sustainable innovation are limited by technological knowledge and development (Bocken et al., 2014).

¹⁸ Source: <https://www.undp.org/content/undp/en/home/sustainable-development-goals.html> - Consulted on 30/12/2019

In order to innovate their *BM*s, firms must apply relevant transformations to their internal organizational structure¹⁹ and they must consider altering their organizational culture. Based on the intensity of the variations, i.e. how radical and encompassing, these may establish obstacles to the implementation of the new *Business Model*. This is what emerged also in the case studies presented in the next chapter (*Leih, Linden and Teece, 2015*).

Besides problems due to the organizational culture, other difficulties that managers or entrepreneurs may encounter in the implementation of the new business practices, may be due to the lack of knowledge and previous experience in handling different activities and in developing higher technological products and especially in the case of providing high quality services (*Chesbrough, 2002; Matschewsky, Kambanou and Sakao, 2018*). Even when the right new *Business Model* is promptly recognized, there may be complications due to conflicts with the existing core business or with the previous configuration of assets. In all these cases, there is a need to identify a “change” leader, who will be able to manage the results, deliver a new and better *BM* and find a way to overcome the cultural problems in order to embrace the and maintain a balance between the new model and the previous one that is fundamental in the case of *Servitized Business Model*.

Developing and constructing new business practices requires exploration, development and implementation activities (*Leih, Linden and Teece, 2015*). These can be grouped, according to *Teece (2007)*, in 3 main categories based on the dynamic capabilities (*Teece, 2018; Pieroni, Mcaloone and Pigosso, 2019*). These categories are subsequent clusters of managerial activities and are described as follows:

- *Sensing*: all the activities related to identifying and assessing opportunities. It is the phase in which companies are trying technological novelties and exploring new markets. It is mostly the case of the first case study later presented, where the Energy manager is still trying to develop a new *servitized Business Model*. Managers should be entrepreneurial by looking ahead of existing practices and recognizing customers’ needs that has not yet been satisfied. Indeed, in this cluster most processes are related to listening to customers’ requests and changing needs and studying the business environment, while trying to identify new opportunities. The necessary knowledge must be searched in all the levels of the organizations, from the bottom to the top management, but the most valuable one must come from the top management.

¹⁹ Companies that implement *servitized Business Model* sometimes create dedicated business units (*Oliva, Gebauer and Brann, 2012*)

- *Seizing*: resources are gathered and deployed internally and externally in order to address opportunities. They are organized in a structure that is able to capture value from customers through the means of providing them valuable innovations. The second case study is this phase where the company is seizing the identified opportunities by identifying, establishing control and influence over complementary and needed assets with the objective of creating and delivering value to customers. In this phase, it is fundamental to be able to successfully manage assets and resources because companies that aim at innovating must be capable of building a global supply chain and of establishing alliances and joint ventures. They should create a network capable of making the innovation work in the market.
- *Transforming*: the company keeps changing and renewing itself. The management of activities related to this phase is relevant again for the second case study, where the company is always looking ahead in order to develop new service offerings as will be further explored later. Changing business practices in firms requires many capabilities. In particular, firms must be able to phase out old products that are not successful anymore and consequently adjust communication based on the changes. As transformations happen, *Business Models*, methods and organizational culture must adapt.

In *Business Model Innovation*, managers usually strive to overcome barriers to change and try to experiment by starting to modify only part of the structure in the company. In order to facilitate this process, the construction of maps is a useful tool: mapping and decomposing the components of a *Business Model Canvas* may be helpful in understanding the relevant elements (Chesbrough, 2010). *Figure 4* is hereby presented as an example of a decomposition of the *BM components*.

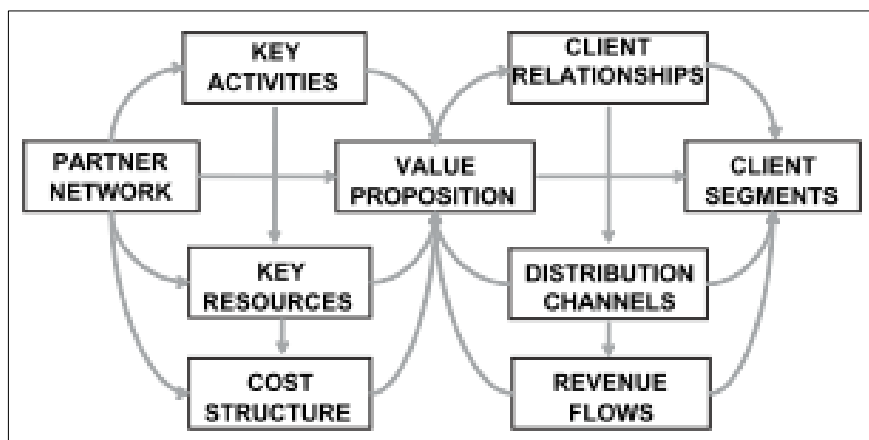


Figure 4. Decomposition of BMC components. Source: Chesbrough (2010)

Executives and entrepreneurs must be able to select the right architecture by assembling the evidence about cost level, customer segments, needs and willingness to pay and about distributors, suppliers and competitors positioning. By doing these, they make guesses about future behaviours. There is a need for firms to be faster than an environment that is changing at a much quicker rate than the one they can keep up with. This highlights a requirement for systematic deconstruction of traditional *Business Models* and in this process, each element must be examined for being refined and/or replaced. In particular, *BM components* must be designed and transformed in relation to customers' needs²⁰, business environment and the trajectory of technological development (Teece, 2010).

A fundamental element is the ability of the company to change the way in which they capture value thanks to innovative value propositions. This is particularly achieved by development of new *revenue models* (i.e. otherwise called *revenue architecture*). As already mentioned, this is the way in which companies gather monetary value from customers with the aim of fostering economic growth and it is the necessary condition for delivering a successful *environmentally sustainable/circular economy* strategy (Doualle et al., 2015). It is worth mentioning that the difficulties in developing these new monetization models are strictly related to the level of change that is required to the *Business Model* (Teece, 2010), which in the case of *servitization* is high. Indeed, combining services and products is challenging for companies that must create suitable tools to capture value from customers (Parida et al., 2014).

Besides capturing value, the other key clusters in *Business Model* construction are: *Value Creation* and *Value Delivery*. Taken together, these three represent the same three categories highlighted in the framework for *Service Transformation* (Reim et al., 2017), that was described in the previous chapter. These clusters present some differences with the groups described for *sustainable Business Models* that were discussed in section 1.1.2. These are:

- in the framework for *sustainable Business Models*, the first cluster is given by the *Value Proposition*, which is a macro category composed of *value proposition offering*, *customer segment* and *relationship*, while the second cluster is given by the combination of activities that are able to create and at the same time deliver value (i.e. *Value Creation and Delivery*).
- in the framework for *Service Transformation* and, more in general, in the *Business Model innovation literature* (Teece, 2010; Baden-Fuller and Mangematin, 2013; Reim et al.,

²⁰ In this study, customers' needs are identified with a request for a business practices that are more environmentally sustainable.

2017), there isn't the *Value Proposition* cluster, which is substituted by two separate groups, that are *Value Creation*, which is comprehensive of resources utilization and customers relationship management (*Baden-Fuller and Haefliger, 2013*); and *Value Delivery* which is related to network distribution and organizational procedures for managing the *PSSs* provision.

In the analysis of the case studies presented in the following chapter, the theory used will be drawn by a combination of the two different frameworks and it will be described more in details in the following section. In particular, in the codifying procedure, which will be later presented, the use of the three clusters presented in the second framework, i.e. *Value Creation, Value Delivery and Value Capture* was considered more appropriate. These groups emerged as a suitable method for investigating the environmentally sustainable impact of *Servitized Business Models*, relying on the idea that facing *Environmental Sustainability* challenges needs a transformation in the way in which companies create, deliver and capture value from customers. In this regard, academic literature is seemingly agreeing that *Servitization* and *PSS business models* are a possible solution to this issue (*Bocken et al., 2014; Reim et al., 2017; Kjaer et al., 2018; Pieroni, Mcaloone and Pigosso, 2019; Pieroni, McAloone and Pigosso, 2019*).

2.2 Investigating Environmental Sustainability/CE in PSS Business

Models

As previously explained, the need for a radical transformation of companies' *BM*s is emerging in the literature stream focused on how to face the issue of the need for increasing environmentally-sustainable business approaches: firms need to substitute their product-centric strategies and become increasingly service oriented (*Bressanelli et al., 2018; Doni, Corvino and Bianchi Martini, 2019; Pieroni, Mcaloone and Pigosso, 2019*).

In particular, in the *Environmental Sustainability (ES)* literature, a key role is played more and more by *PSSs business models*, because they are often identified as enablers of improved environmental performance thanks to their ability to increase companies' resource efficiency. As already explained, they describe integrated offers that are developed and implemented to satisfy customers: by employing these kind of *Business Models*, companies are forced to move the focus of their business activities from one-shot sales to the provision of services that concern with the whole lifecycle of physical products (*Matschewsky, 2019*). Due to this

frequent correlation between *Product-Service systems* and environmental challenges, this work has the aim of understanding whether services do provide an answer to sustainable development in manufacturing companies and what are the main strategies and effects of these business practices in relation to reduced environmental impact.

In this regard, *Pieroni et al. (2019)* studied *PSSs* and their implications as *BMs* able to achieve *ES* and *CE*. One of their key findings is fundamental for assessing *PSS business models* and their contribution to *resource decoupling*, i.e. business strategies capable of providing and keeping products with the highest value, while consuming as few resources as possible (*Kjaer et al., 2018; Matschewsky, 2019*). By developing an action research, they could identify three conditions that must be satisfied simultaneously in order to achieve superior environmental performance. These conditions are the following (*Pieroni, Mcaloone and Pigosso, 2019*):

- *Reach sustainable economic growth*: gaining positive economic results is once again identified as fundamental in the perspective of developing environmentally-friendly business activities. Companies must be able to capture the increasing value that is delivered to customer and, consequently generate financial resources that are relevant for the survival of the firm and their ability to keep generating positive results for the environment. Indeed, as it was explained before, companies are not in the position to successfully implement “greener” *business models* if they do not come together with increased financial growth.
- *Delivering superior customer value*: companies must be able to identify and satisfy new and more demanding customers’ needs, by making them perceive the increased benefits of receiving a combined product/service offering, as opposite to the possible sacrifices that the customer has to tolerate (e.g. externalising to suppliers private production data).
- *Fulfil a resource decoupling potential*: firms’ *Business Models* classify as *circular economy strategies* or as *environmentally-sustainable* if they are able to perform activities that keeping output level constant, consume much less resources than traditional activities. In this work, *resource decoupling* is verified through the *product-service strategies* identified by *Kjaer et al. (2018)* and described in the previous chapter. The baseline concept is that *PSSs* should be able to reduce wastes that are caused by the ineffectiveness of current systems, due to bad product design and fast obsolescence, sub-optimal processes, outdated laws and overconsumption or misuse of products (*Kjaer et al., 2018; Matschewsky, 2019*).

In order to analyse the achievement and the effectiveness of the two case studies presented in the last chapter, these three simultaneous conditions were studied and decomposed through the use of *Business Model* activities and components. Indeed, these are useful not only to identify the transformations that were made by companies in their *BMs* in order to deliver *service-oriented* offering, but also to recognize whether and how these changes are able to effect and influence the environmental challenges that the current society is facing.

Practically, in order to classify *PSS* as strategies that are able to reduce negative impact of business activities to the environment, each of the three condition (i.e. *economic growth*, *superior customer value*, *resource decoupling*) has its own correspondent in one of the three clusters identified in *Business Model Innovation* literature and *sustainable Business Model* identification (i.e. *Value capture*, *Value creation*, *Value delivery*). Inside these clusters, specific activities were determined by using both *sustainable Business Model components* (Bocken et al., 2016; Tunn et al., 2018) and elements typical of *Business Models* for *Service Transformation* (Adrodegari and Saccani, 2017; Reim et al., 2017). These three clusters are presented in details in the following sections.

2.2.1 Economic growth through value capture

Companies grow economically by being able to capture value from customers by the means of earning revenues from the provision of goods, services and/or information to their clients (Teece, 2010; Bocken et al., 2014). Through increased revenues, companies are economically sustainable and gain the financial resources that are necessary for keeping operations and processes going in the long period. It is important to dedicate particular consideration to the issues of how to capture and seize portions of the value created by companies.

In order to reach *economic growth*, companies must be able to build and define an effective “*revenue architecture*”, which summarises all dynamics and logics related to customer payments (i.e. *how and how much should be charged?*) and how the value created is allocated among their customers, the *OEMs* (i.e. the *original equipment manufacturers*) and its network of suppliers. And thus, how value is apportioned along the whole supply chain (Chesbrough, 2002). In particular, it is relevant in this cluster of activities to decide how to practically monetize *Business Models*, which is a concept comprehensive not only of pricing strategies, based on the customer perception of the value of the *product-service offerings*, but also of

timings of payments and methods for collecting revenues (*Baden-Fuller and Haefliger, 2013*).

Pricing is one of the key concerns for companies that are developing *servitized Business Models* (*Mathieu, 2001*). Especially with the aim of designing sustainable *Product-Service systems*, companies must be able to construct offerings that capture customers’ attention. They must be valuable enough to them: clients must be willing to pay for the added value that is delivered through services. Simultaneously, companies must be able to handle cost efficiently in order to increase firms’ profitability (*Reim et al., 2017*).

In the servitization literature, services provided to enhance product offerings by manufacturing companies have a complex relationship with the financial performance, even though in general there is a positive effects (*Neely, 2009; Opresnik et al., 2013*). Services provide more constant revenue streams and their margins are higher than in the traditional product business, which ensure a way to reach economic growth.

In order to measure the results of economic growth deriving from the ability to capture value, two main elements were identified as essential. These are the “*structure of the revenue model/revenue architecture*”, more specifically the monetization model, and the “*economic sustainability of servitized Business Model*”, which should prove firms’ ability to foster economic growth in delivering services.

A summary of the components grouped in this cluster is presented in *Table 5*.

Table 5. Summary of BM activities for capturing value. Source: Own elaboration

Value capture
Structure of the revenue model
Economic sustainability of the servitized Business Model

2.2.2 Creating superior customer value through value creation

Value Creation is at the core of any business activity (*Bocken et al., 2014*). Specifically, when analysing sustainable *PSS business models*, it emerged that they are able to create enhanced value for customers in many ways. Most of these are related to the ability of the company to interpret and satisfy customers’ needs and their competencies in properly communicating their value proposition (*Parida et al., 2014*). Thus, if a company is able to create value for customers, it is producing superior customer value in respect to their competitors.

Customers play the most important role in this cluster. Most of the time, *Business Models* are capable of creating value through their ability of solving their problems. Identifying clients means that firms have determined the targeted users they want to reach (*Baden-Fuller and Mangematin, 2013*). They are usually divided into different market segments based on physiological or other types of features. These segments form groups that must be specified in the *Business Models* and they are the ones for that companies' value proposition is appealing (*Chesbrough, 2002*).

Value proposition is another important element needed for *Value Creation*. Traditionally, the value proposition is related to the product or service offering that is able to generate economic return for companies. In a *servitized Business Model*, this is made of a combination of physical products and intangible services and moving to the *ES* concept, the value propositions are the ones that are able to perform activities in a way that is more environmentally efficient. In this perspective, companies are able to enhance their relationships with customers and, consequently, they can install loyalty into clients (*Tukker, 2015; Reim et al., 2017*). In this cases, value is created through delivering positive effects for the environment because material consumption is reduced and resource utilization is increased (*Mont, 2002; Tukker, 2004; Reim et al., 2017*).

Moreover, when creating value, companies exploit resources. In the first chapter, when presenting the two business models for *service transformation* by *Adrodegari and Saccani (2017)* and by *Reim et al.(2017)* a key component for value creation was *resources utilization*. For *servitized Business Models*, *Adrodegari and Saccani (2017)* recognized the importance of internal and external assets such as financial resources, human resources and technologies. Those three represent the basis from which companies can start constructing their product service offerings.

A summary of the components grouped in this last cluster is presented in *Table 6*.

Table 6. Summary of BM elements for creating value. Source: Own elaboration

Value creation
Customers
Value proposition as a bundle of products/services
Resources for servitized BM development

2.2.3 Reaching Resource Decoupling through Value Delivery

Value Delivery identifies the mechanisms through which the value created by companies finally arrives to customers. Specifically, value is usually delivered through value chains and governance systems (Baden-Fuller and Mangematin, 2013). In providing PSSs, this are characterized by the level of competencies and experience of the companies in delivering services, because providing value to customers through products or through services is different. Partners and organizational structures need to be adapted to service delivery. Thus, firms must develop specific networks for delivering services by interchanging the implementation of partnerships for external distribution and the establishment of new routines across business subsidiaries (as in the first case study) and/or across business units (as the second case study) (Reim et al., 2017).

In the perspective of *Environmental Sustainability* and *Circular Economy*, this last cluster of *BM elements* is the most important. This is due not only to the fact that it enables to highlight how companies and firms actually deliver value through service provision, which would be the traditional component of “*key activities*” (Osterwalder, Pigneur and Tucci, 2005; Adrodegari and Saccani, 2017). But also because through the identification of *product/service strategies*, as in the previously mentioned work of Kjaer et al. (2018), the present study aims at identifying how companies can achieve *Resource Decoupling*.

Resource Decoupling has the main aim of separating economic growth from resource consumption (Fischer-Kowalski et al., 2011). This practice has the goal of reducing the rate of resource depletion and the level of costs, by increasing the productivity of resources, reducing the environmental impact of business activities. It can be of two types (Kjaer et al., 2018; Matschewsky, 2019).

- *Relative resource decoupling*, happens when companies focus on reaching a reduced environmental damage per growth rate. Basically, in the PSS context, it identifies the relation between resources consumption of PSS offerings compared to resources consumption of traditional product sales over a certain amount of customer value. If PSSs consumes fewer resources than traditional product sales, while creating the same amount of customer value, than *relative resource decoupling* is actually happening. In this case, there are three aims that should be reached to unlock *resource decoupling*:
 1. *Decrease the need for resources during the product use* (i.e. lower amount of resources needed during product use).

2. *Decrease the need for producing the product* (i.e. products life cycle is longer, thus less products are needed and less resources are wasted).
 3. *Displace more resource intensive systems* (i.e. search for alternative systems, product or raw material, with the aim of enabling a net resource reduction).
- *Absolute Resource Decoupling* happens when independently from the growth rate, resources use declines. In practice, the total amount of customer value is increasing, while the total amount of resources consumed by PSS is decreasing. In particular, this is reached when the following requirements are satisfied:
 1. *ensure net resource reduction* (i.e. the resources avoided in displacing the PSS system must be lower than the induced resources used for offering the PSS).
 2. *avoid burden shifting between Life Cycle Stages* (i.e. ensure that the optimization of one life cycle, doesn't lead to increased resource consumption in other life cycle stages).
 3. *mitigate rebound effects* (i.e. implementing an improvement in production of consumption through increased efficiency liberates or binds scarce production or consumption factors).

The baseline concept is that through *PSSs* strategies, which are grouped in the component “*service provision*” and are the same strategies that were described in section 1.2.3 (i.e. *operational support, product maintenance, product take-back/EoL management, product sharing, optimized result*), companies are able to reach in the first-place relative resource reduction and in the second-place absolute *resource decoupling*. This concept is represented in *Figure 5*.

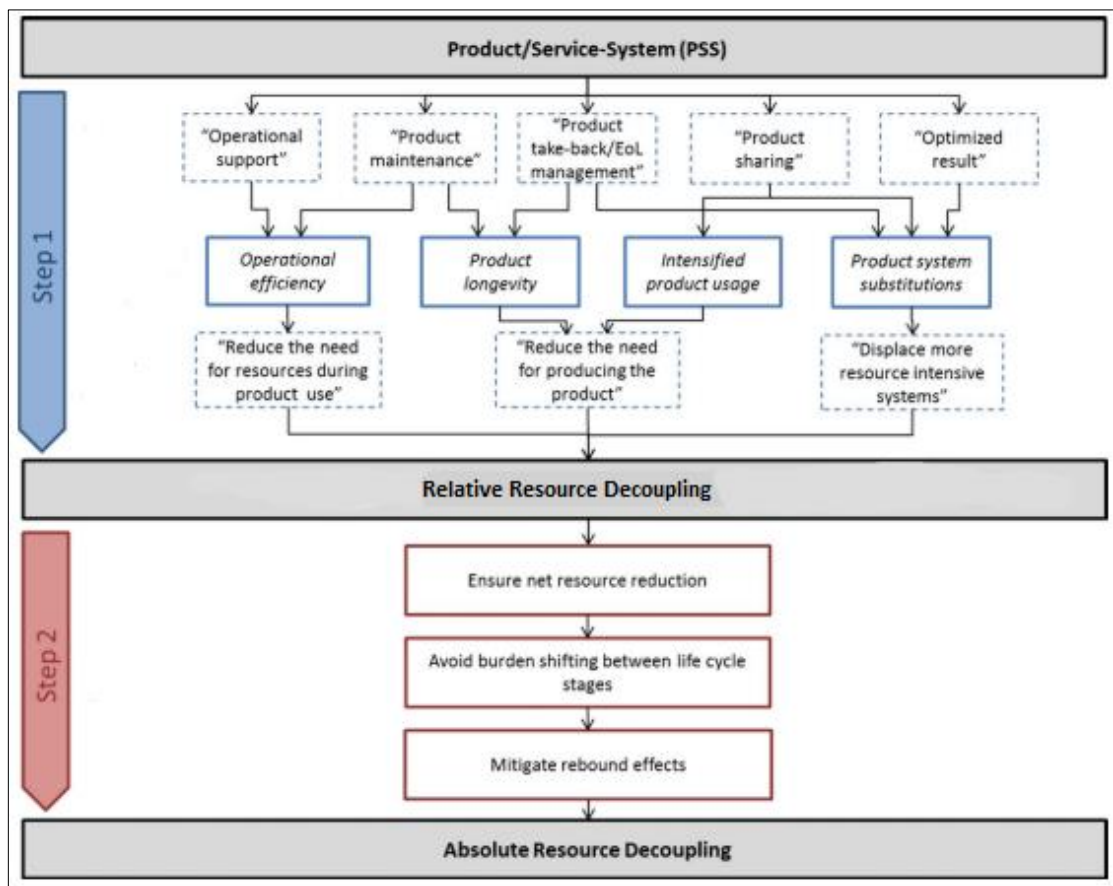


Figure 5. Summary of Resource Decoupling effect of PSS. Source: Reworked version from Kjaer et al. (2018)

Firstly, when companies implement *Business Models* such as *PSSs*, they are implicitly enabling resource reduction thanks to 4 specific “enablers”, that were identified by *Kjaer et al.* (2018). In general, the effect of each of these “enablers” depend on both the strategies and the type of *PSS BMs* (i.e. whether a company is implementing a product-oriented, a use-oriented or a result-oriented service). More in details, these potential *resource decoupling* enablers are:

- *Operational efficiency*: strategies that are able to incorporate these characteristics, become easily capable of minimizing resources utilization during the use phase of a product. This is critical for products such as manufacturing machines that consume a lot of resources (e.g. energy) when they are being used for production and that are characterised by a long life-cycle. *Resource decoupling* happens in this case because through service delivery companies are able to lower the customers demand for energy and materials.
- *Product longevity*: due to planned and perceived obsolescence customers usually change products many times in a limited period causing a fast turnover and waste of resources. When *servitization strategies* operate in the light of this *enabler*, the main aim is to

support users in order to increase products' life-cycle, extending the use stage to minimize the related waste of resources.

- *Intensified product usage*: this *enabler* is focused on the development of sharing systems. In particular, it is related to *use-oriented business models*, even though it is relevant also in the case of *result-oriented business models*. The basic notion is that through shared use of products; they can be utilized eliminating the risk of sub-utilization of products. In this study, this enabler has not been encountered, thus it is less relevant than the two previous enablers and won't be presented again.
- *Product system substitutions*: this is concerned with changes in the way in which users satisfy their need (e.g. remote monitoring, instead of physically going into the shop for anomalies). It is important the first case studies presented in the following chapter, and at the product level, it focuses on shared reused products or recycled materials.

A summary of the components grouped in this last cluster is presented in Table 7.

Table 7. Summary of BM elements for delivering value. Source: Own elaboration

Value Delivery
Creation of a network for service delivery
Service provision

2.3 Methodology for the analysis of the Case Studies

This final part of the chapter is dedicated to the explanation of the practical methodologies used with the aim of selecting, analysing and codifying the case studies that will be presented in the following chapter. The goal is to provide full clarity in the processes that were exploited in order to deliver qualitative data through the use of business cases.

2.3.1 The process of selecting Case Studies

The aim of this study is to provide a qualitative investigation in order to examine the *Environmental Sustainability* effect of delivering *Product-Service Systems* offerings. Using the theoretical frameworks presented in the first sections of the present chapter and concepts

from *Chapter 1*, the main objective of case studies analysis is to understand whether the correlation between *PSSs* and *environmental reduced impact* is verified.

The cases presented in this study were selected based on specific criteria. The initial goal was to explore the process of *business model innovation*, that is highlighted in literature as a needed requirement for bringing *environmental sustainability* and *business concerns* together (Lüdeke- Freund, 2010). For this reason, the companies selected are implementing a particular kind of *Business Model Innovation*: they are in the process of adding services offerings to their traditional product businesses. Indeed, in order to improve the environmental performance, *business model innovation* must be specifically devoted to implementing services. It is important to create specific *servitized business models* such as *Product-Service Systems* (Tukker, 2015; Barquet et al., 2016; Li and Found, 2017).

After examining these considerations, the main characteristics of *Product-Service Systems Business Models* were identified, in order to decide which cases should be selected. In particular, it emerged that, by definition, the firms needed for the qualitative analyses should be characterised by addition of services to their traditional physical product offerings. This is why the companies chosen present service offerings as a feature. These companies not only have services as distinctive characteristics, but they also are characterised by being manufacturing companies. Indeed, the focus of this work is the manufacturing industry.

The reasoning is that *PSSs* are presented many times as being able to deliver environmentally enhanced performances, if companies are able to create value for customers by eliminating the need for ownership. The problem, especially in B2C industries, is that clients value owning a product (Tukker, 2004, 2015; Bressanelli et al., 2018). Thus, it is difficult to successfully implement this servitized business models in B2C industries. On the contrary, in the B2B industry, companies should be keener on renouncing products ownership, because they focus on handling production of physical goods. As a consequence, they should accept the externalization of the maintenance or the optimization of machinery use and should be less interested in physically owning the machine (Tukker, 2015). This is the reason why the companies selected are manufacturing firms operating in the *B2B industry*. In particular, the firms are two OES supplying to *OEM customers* machinery for production/service delivery.

They are the following two:

- *Energys S.r.l.*, an Energy Service company (an ESCo) which is concerned with delivering services that improve energy consumption in customers machinery operating mainly in the plastic industry. This company is part of Piovan Group²¹;
- *Arneg S.p.A.*, a company dealing with the design, production and instalment of equipment for the retail sector and with the delivery of remote maintenance services through a dedicated business unit²².

By taking into consideration *Tukker's* classification of *Product-service Systems BMs* (2004), these two companies present the features of a product-oriented BM: they both sell the ownership of their products to customers. The initial aim was to find one company for each of the three types of business model presented in the *PSSs literature*, but in the Italian manufacturing industry (i.e. the specific context considered for the study), the move toward services is only at the initial stage²³. For this reason, it was not only difficult to find companies that classify as *use-oriented* or *result-oriented business model*, but also it was considered not significantly representative of the Italian context due to the limited number of cases in which these *BMs* are actually implemented.

Companies that are aimed at improving their environmental performance must innovate their *Business Models*. They should develop and implement *Product-Service Systems strategies* and are required to find the proper organizational structure to explore services activities and delivery, while at the same time exploiting the resources employed in the traditional *product centric business model*. The other selection criteria was then derived from the concept of organizational *ambidexterity*, which is the business practice by which companies are simultaneously exploiting resources and exploring new market opportunities (*Duncan*, 1976). In the *PSSs context*, what could happen is that companies exploit the financial resources yielded by the *physical product business*, i.e. *exploitation of the cash cow*, and dedicate part of their organizational resources to explore service innovation, i.e. *exploration of new business opportunities* (*Judge and Blocker*, 2008; *Raisch et al.*, 2009; *Voss and Voss*, 2013).

²¹ Source: <https://www.piovan.com/en> (Consulted on 05.01.2020)

²² Source: <https://www.arneg.it/it/azienda/chi-siamo> (Consulted on 05.01.2020)

²³ In an industry study by KPMG (2019), it was highlighted that only 30% of the companies in the sample offer customer service to more than 75% of their customers and inside this 30%, only the 60% of the cases are customers with a stable relationship over time. Source: <https://www.innovationpost.it/2019/11/14/dalla-after-sales-al-customer-service-4-0-il-servizio-come-fattore-chiave-per-la-crescita-del-manifatturiero/> (Consulted on 05.01.2020)

In this context, companies have to re-organize their structure for delivering services by choosing between different types of *ambidexterity* practices: differentiation and integration. Differentiation means to have distinct organizational units that develop appropriate contexts for exploitation and explorations, while integration refers to all mechanisms that allows firms to address the two within the same organizational unit (*Raisch et al., 2009*). The two manufacturing companies were selected with the aim of giving an example of how companies can implement *PSSs*, with the two different perspective of *ambidexterity*:

- *Energys S.r.l.* as an example of differentiation, since it is the dedicated service company of the parent company *Piovan S.p.A.*, that decided to devote a separated business unit, which is formally a company on its own, to the provision of energy management services to its customers.
- *Arneg S.p.A.* as an example of integration, since the service offerings has been developed within the same company.

With the aim of providing a clear explanation of the reasoning that followed the selection process of these two case studies, all the theoretical considerations and the according to which these two cases were selected is summarised in *Figure 6*, where each stage of the analysis is represented by a different box in the flow.

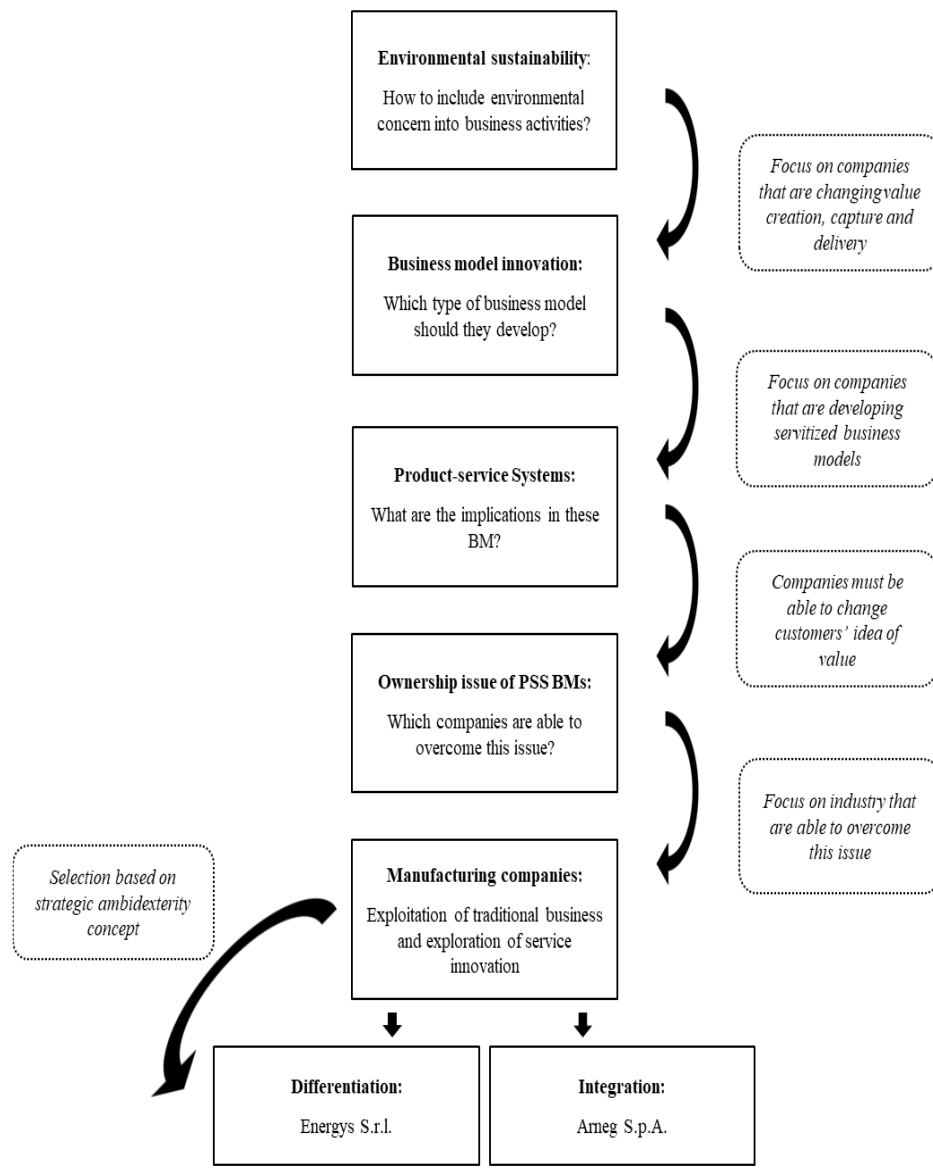


Figure 6. Representation of the stage analysis in case study selection process. Source: Own elaboration

Besides these two case studies, another subject was identified for a qualitative interview in order to understand the general context that this study is analysing. This was chosen based on the notion of business ecosystem and the importance it plays in developing service innovation for *environmental sustainability*. This kind of *Business Model Innovation* requires cooperation among business partners and recurring interactions among all firms along the value chain. Each firm is part of a business ecosystem that crosses many different industries operating in a particular environment. In this context, organizations transform their capabilities in order to adapt to new changes by working together with the aim of introducing new products or services and be ready to always satisfy new customer needs (Moore, 1993). An illustrative example of a business ecosystem is represented in *Figure 7*.

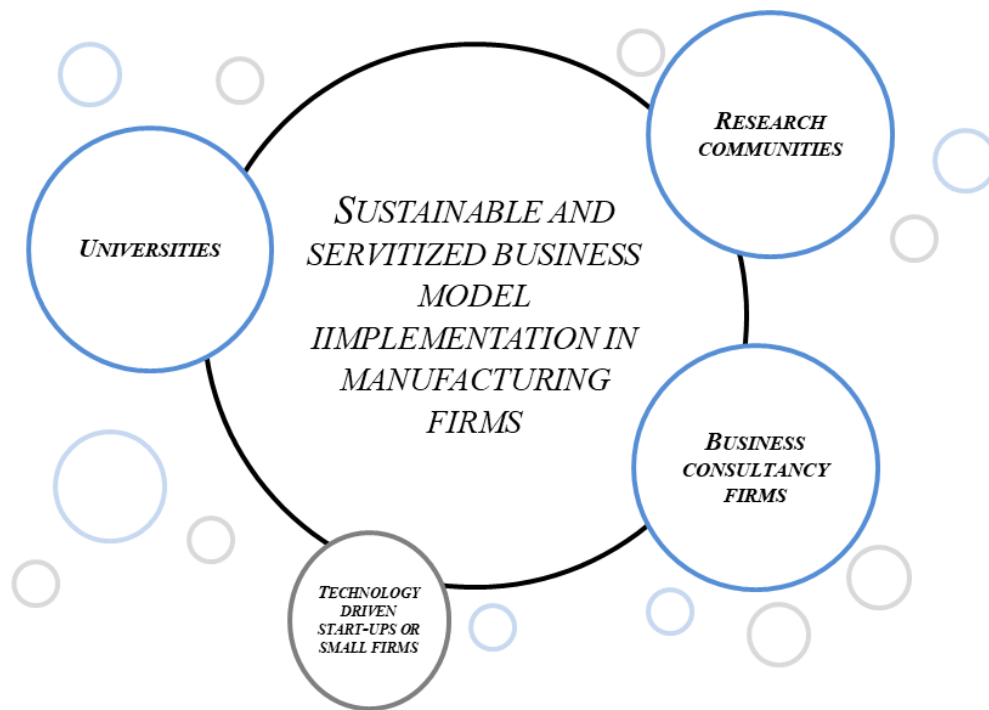


Figure 7. Representation of a business ecosystem. Source: Own Elaboration.

Developing services in innovative firms requires mutual learning and openness to other players in the networks in order to acquire new knowledge: PSSs are created through co-operations with other firms (Tukker, 2004). In addition, moving to the *environmental sustainability/circular economy*, it is relevant that companies develop partnerships and linkages with other firms because they facilitate the acquisition of highly developed skills and increase information gathering about the effectiveness of their sustainable development (Roome and Clarke, 2002). Also, one of the most important requirement for implementing practices such as *Circular Economy* is to create networks for physically allowing *resource decoupling*²⁴ (Fischer-Kowalski et al., 2011). Companies do not have the knowledge and the tools to be able to implement this kind of services on their own. They need partners: partners for acquiring knowledge for service development or partners for physically developing and delivering these services.

Building on the reasoning of external knowledge acquisition, the other interview was carried out with an expert working in University and in a research community aimed at studying and helping firms in the process of service implementation. It can be classified as a partner that is supporting *Original Equipment Suppliers (OES)*, such as the companies of the case studies, in defining and implementing their new *servitized Business Models*.

²⁴ This is extremely important in remanufacturing strategies, in whose cases network creation is embedded in the BM implementation

The aim of this interview was to gather knowledge about trends in the industry and about how companies are reacting to two focal issues of this work, which are *services* and *environmental sustainability*. More precisely, the other subject interviewed was an *Academic professor*, who operates in a community²⁵ that deals with *service management*. This community is concerned with research, training, network and solution development in the issue of *servitization* and it is composed of many university researchers, companies, managers and professionals that deal with these *BMs changes* and associations of various kinds.

Finally, besides this academic expert, a consultancy company²⁶ was briefly consulted for an overview on the *environmental sustainability* issue. This was not analysed with the same process of the other subjects because the interview was carried out by e-mail and only their brief answers about the *environmental issue* were considered and used in the last chapter as an introduction the case studies presentation and discussion.

2.3.2 The process of collecting data

The aim of this study is to understand in which way the development of new *business models* such as *Product-Service Systems* can concretely contribute to improving environmental performance of manufacturing firms. In addition, in the context of *PSSs*, it presents an analysis of both challenges that needs to be overcome, and drivers, whose development should be encouraged, with the aim of fostering the implementation of such *BMs* in the perspective of *environmental sustainability*.

The present analysis exploits the *case study research*, where case studies are a description of a management situation (Bonoma, 1985). This method allows implementing early exploratory investigations about issues that are currently being studied and tested, such as the correlation between *environmental sustainability/circular economy* and the *servitization phenomenon*. Furthermore, it allows to make hypothesis and suggestions based on the features of the specific cases and the theory that is extracted from them (Voss, Tsikriktsis and Frohlich, 2002). In this regard, exploration is needed to develop research ideas and questions which are the goals of this study.

²⁵ ASAP Service Management Forum. Source: <http://www.asapsmf.org/finalita-e-mission/> (Consulted on 13.01.2020)

²⁶ Nativa S.r.l. SB is a purpose driven design & innovation company that deals helping companies in incorporating innovation and sustainability in their every-day activities and developing benefit unit and entrepreneurial projects that contribute to social and environmental welfare “by design” (Nativa S.r.l. SB, 2019).

Besides exploration, case studies research can be used also for theory testing, even though it is not used very often. When case research is used with this aim, it is important to achieve triangulation. This is the practice of using and combining different methods of information gathering in order to achieve a high level of reliability in the study of a phenomenon (Bonoma, 1985; Johnston, Leach and Liu, 1999; Voss, Tsiriktsis and Frohlich, 2002). Triangulation is very important in discussing strategy issues because it promotes the use of multiple sources of data and this is fundamental in order to test theories that have already been discussed (Johnston, Leach and Liu, 1999; Voss, Tsiriktsis and Frohlich, 2002).

In order to achieve investigate the research topics, qualitative data were gathered through explorative interviews. These interviews were carried on with the aim of exploring areas for research and theory development about how to foster business approaches that are *environmentally sustainable*. In this regard, the research questions can be grouped into three clusters. The first research question aims at exploring why manufacturing companies approach the topic of *environmental sustainability* and this was investigated with the industry expert and the consultancy company and by exploring environmental approaches of the two case studies. The research question is the following:

(a) *What are the reasons for approaching environmental sustainability in manufacturing companies?*

The following group of research questions focuses on the characteristics a *servitized business models*. The aim is to identify whether the strategies implemented by the case studies classify as *Circular Economy strategies* or whether in general they allow companies to reduce their impact toward the environment.

(b) *What are the components of Product-Service Systems business models relatively to value creation, capture and delivery?*

(c) *Do they fulfil the three requirements in order to classify as Circular Economies strategies/environmentally sustainable business approaches?*²⁷

The last group of research questions regards the difficulties and drivers in implementing *servitized Business Models*. The foundation is that if *servitized Business Models* in the case studies classify as *environmentally sustainable*, then it is important to work on their drivers and challenges in order to be able to foster their implementation in manufacturing firms.

²⁷ This is measured by the three conditions for PSS to classify as CE that are economic growth, superior customer value and resource decoupling (Pironi, Mcaloone and Pigosso, 2019).

(d) *What are the most frequent challenges that make it difficult for manufacturing firms from implementing such business models?*

(e) *What are the most frequent drivers that make manufacturing firms decide to implement this type of business model?*

In order to gather data, explorative interviews were carried on with two different types of subjects. These represent two level of the analysis, which are described as follows:

- *Industry expert*, coming from academic research community about services. This was fundamental in order to gather data about the context in which manufacturing companies operates and the relative trends in the manufacturing firms industry in the issue of *services, PSSs, and environmental sustainability/circular economy*. This is the first level.
- *Companies' energy managers* for the case studies of *Energys S.r.l.* and *Arneg S.p.A.*; these energy managers are the responsible for service creation and delivery in their respective companies. They are the more experienced and valuable source of information for both understanding the content of service offerings in manufacturing companies and the challenges and drivers they are encountering in *service implementation*. This is the second level that is represented by detailed analysis of actual manufacturing companies.

The decision to interview these figure comes from the fact that managers inside firms are the ones that really know what goes on: they have all the information about the dynamics and the strategic plans both in the long run and in the short run. Thus, they are able to better examine and explain the activities they are performing (*Baden-Fuller and Morgan, 2010*).

As previously mentioned, data were gathered through explorative interviews. Explorative interviews are unstructured and are used with the aim of developing ideas and research. Usually they are carried out by starting with a list of topics that are planned to be discussed, but the structure of the interview is not well defined²⁸. This is the same structure that was used for carrying on the interviews both at the first level and at the second level. Indeed, this method was considered useful due to the explorative nature of this work. In particular, it allowed to make adjustments as issues or topics emerged (e.g. new questions were asked as particular topics emerged). Examples of the topics and questions asked during the interviews can be found in the appendixes 1, 2 and 3.

²⁸ Source: <https://www.qualityresearchinternational.com/socialresearch> (Consulted on 14.01.2020)

Table 8. Summary of the interviews and case studies analysed during this study. Source: Own elaboration.

<i>Sources #</i>	<i>Subject</i>	<i>Manufacturing firm</i>	<i>Industry expert</i>	<i>Case study</i>	<i>Date</i>	<i>Length</i>
1 and 2	Energy Manager	X		Energys S.r.l.	15/05/2019	47' 32"
					21/11/2019 ²⁹	36' 00"
3	Energy Manager	X		Arneg S.p.A.	19/12/2019	2h 35' 14"
4	University professor		X	ASAP SMF	20/01/2019	26' 26"

It must be noted that the Energy manager of *Energys S.r.l.* was interviewed more than once. In this specific case a follow up was performed. This was due mainly because at the time the first interview was carried out the energy manager was already delivering energy management services to its customers, but her aim was to implement a new enhanced *servitized business model*. Thus, it was decided to wait a few months with the objective of checking for improvements in new service implementation. This was helpful also with the aim of investigating the relative challenges she was trying to overcome and the process she was following in its development.

The data collection was performed through explorative interviews with different subjects (as summarised in *Table 8*), that were classified as:

- *Manufacturing companies (source #: 1; 2; and 3)*: for these energy managers were interviewed. These were the actual case studies that were examined and that are presented in the next chapter.
- *Industry experts (source #: 4)*: for these a university professor was interviewed. This expert that was consulted for a general contextualization and identification of general trends in the manufacturing industry.

In order to increase reliability of data gathered in relation to the case studies, especially with the aim of performing theory testing about *PSSs contribution to circular economy/environmental sustainability*, triangulation was achieved. The main sources of data gathering for multiple data collection were: companies' website; companies' sustainability reports, newspaper articles about the case studies examined and/or written by the interview experts. These are summarised in *Table 9*.

²⁹ An interview follow-up was performed with the aim of verifying implementation stage of the new business model.

Table 9. Summary of multiple data sources used for triangulation.

Sources #	Data source	Case study
I	Bilancio di Sostenibilità 2018 – Piovan Group	Energys S.r.l.
II	https://energys.piovan.com/it	
III	https://www.piovangroup.com/en	
IV	https://www.industry4business.it/servitization/arneg-non-solo-banchi-frigo-ecco-le-opportunita-digitali-della-servitization/	Arneg S.p.A.
V	https://www.arneg.it/it/azienda/chi-siamo	
VI	https://www.arneg.it/it/azienda/programma-naturally-innovative	
VII	http://www.asapsmf.org/	ASAP SMF
VIII	https://www.industry4business.it/esperti-e-analisti/creare-valore-con-leconomia-circolare-opportunita-di-business-e-spinte-verso-la-sostenibilita/	

2.3.3 Transcription, codifying process and data analysis

The first stage of codifying process consisted in recording all the interviews and in typing them up. The transcription of the interviews was then used as a starting base for the subsequent codifying phase. It must be reported that interviews were all conducted in Italian and then during the codifying, the key phrases were accurately translated in order to properly represent the relevant multi-level codes, as reported in the complete codifying table in the *Appendix 1, 2, 3*.

Table 10. Example of the process of translation to English of the original notes. Source: Own elaboration

Interview source	Note #	Original Notes	Translated notes
1	5	Ogni martedì c'è una borsa nella quale sono venduti i certificati bianchi e le aziende sono ripagate cash. I risparmi economici ottenuti grazie a questo processo, sono poi divisi tra Energys e il cliente finale secondo varie forme di partnership commerciale.	Every Tuesday there is a stock exchange where white certificates are sold and companies are paid back cash. The economic savings achieved through this process are then divided between Energys and the end customer according to various forms of business partnership.
2	89	Ogni azienda ha il suo modo di produrre e quindi avendo Piovan un "miliardo" di clienti non è che puoi metterti a sindacare o a dare dei consigli su come loro producono o su che cosa loro producono, anche perché non tutti te lo direbbero. Spesso hanno i loro segreti ed è il responsabile della loro produzione che fa questo tipo di analisi.	Every company has its own way of producing and so having Piovan a "billion" of customers, Piovan is not entitled to give pieces of advice on how they produce or what they produce, also because not everyone would tell you. Often they have their secrets and it is the person in charge of their production who does this kind of analysis.

After typing up all the interviews with energy managers and the industry expert, the step immediately after has been the codifying of qualitative data and observations that were transcribed and identified in the case studies (Voss, Tsiriktsis and Frohlich, 2002). This stage of the analysis has been particularly important because it allowed a subjective source for gathering information, which were the unstructured interviews, to become an objective theory whose basics have been used for *theory building* (i.e. developing the concepts of main drivers and challenges for implementing the presented types of *BM*s) and for *theory testing* (i.e. testing whether servitized *business models* have an impact on *sustainability*).

The goal has been to extract objective concepts and construct specific categories by using observations and sentences pronounced by energy managers and the industry expert. The codifying was performed following the codifying scheme by Corbin and Strauss (1990). They proposed three steps for codifying which are *Open coding*, *Axial coding*, and *Selective coding* (Voss, Tsiriktsis and Frohlich, 2002; Douglas, 2003). In particular in the present research, the process performed for codifying interviews was the following:

1. *Open coding*: observations, sentences, ideas and events that have been told by the interviewed subjects were identified based on their properties and their nature. They were given specific names and grouped into *sub-categories* (i.e. “*sub-category 1*” as presented in Table 11).
2. *Axial coding*: *sub-categories* that have been created in the first step are now regrouped in new ways and correlations are identified with the aim of putting together data in a logical manner. Core codes are developed from the open codes. The cored codes in this study are labelled as “*category 1*”.

Table 11. Example of case research codifying. Source: Own elaboration

Interview source	Note #	Translated notes	Sub - category 1	Category 1
1	5	Every Tuesday there is a stock exchange where white certificates are sold and companies are paid back cash. The economic savings achieved through this process are then divided between Energys and the end customer according to various forms of business partnership.	Division of economic savings between Energys and the end customer to capture value	Monetization of the current BM

Interview source	Note #	Translated notes	Sub - category 1	Category 1
3	127	In the last 10 years, since I've been in Arneg... this has caused quite a stir when I showed it, we went from 4 and a half million euros to this year that we'll close at about 37 and a half million euros.	The company is experiencing an impressive revenue growth proving the servitization is financially sustainable.	Current servitized BM is financially sustainable
1	37	The end customer does not have time to go and create it and has difficulty appreciating it because he does not understand it. However, if he receives information or an instruction, which he simply has to follow, it is much simpler and he could be willing to pay for it.	Customers value the provision of support services (information sales) regarding machines functioning	Delivering added value to customers
2	89	Every company has its own way of producing and so having Piovan a "billion" of customers, Piovan is not entitled to give pieces of advice on how they produce or what they produce, also because not everyone would tell you. Often they have their secrets and it is the person in charge of their production who does this kind of analysis.	Customers are not always willing to have external suppliers managing their own data	Importance of customer relationship management for service delivery
3	156	I'll tell you how much you'll consume here. For the sake of transparency, the whole thing is also visible to the customer. He obviously only sees his things, but he sees that the first month he was supposed to consume 36973 at the most instead he consumed 33453.	To increase customer loyalty Arneg gives access to the software also to the customer	Customer relationship is relational and trustful
1	10	This second person is an electrical engineer, and he was the energy manager of a foundry. He is a man used to	Acquisition of external competencies in order to become capable of delivering the current energy	Search for skilled human resources

Interview source	Note #	Translated notes	Sub - category 1	Category 1
		manage processes who manages to give value to the data they collect.	service	
2	56	her idea is based on technological devices that allow to establish communication between the data is collected from the field and taken from the machines and the data that can transferred to the to the cloud and also talk to the ERP.	Development of new software technologies as a resource for the implementation of the new enhanced support service	Technological resources for service development
2	97	On the other hand, for what concerns the recycled raw material, not made from the oil granule, but made of the granule that comes from the grinding of plastic material or separate collection, the technology for producing that type of recycle plastic has not yet been developed.	New product development to exploit opportunities coming from sustainability	Traditional product offerings adapted to produce sustainable products
2	92	But she gains on the fact that it gives the client a chance to have data on which, then, he can take decisions. In practice, the business model she would like to propose is to sell software and, if the client needs it, an analysis service.	Delivering a analysis service of the machine based on the data coming from it (the future servitized BM is product-oriented service)	Delivering an operational support strategy- <i>op. efficiency</i>
3	138	Then service is strictly related to the product, but it differentiates the product until you get to sell the service almost independently, first over the years it was always like this: first the product sale and then we hook the services, now in certain customers enter the services and then we create the hook for the sale, to go and sell, then it was overturned a bit 'the concept.	The services is growing as an offer that is independent from the product, first customers try the service and then they buy the product	PSS offering developed internally through a dedicated service division

3. *Selective coding*: core categories are now related to others, always with the aim of creating groups that correspond to macro theoretical topics. These were basically the *business model components* and the three clusters of *business models* phenomenon that were consistent with the theoretical framework presented in the previous section. In the present study this process was developed through the use of “*category 2*” for business model components and “*category 3*” for the diversification in the three clusters. In the case that core codes didn’t classify as *BM components*, they were categorized either as “*drivers*” or “*challenges*”. This is represented in *Figure 8*.

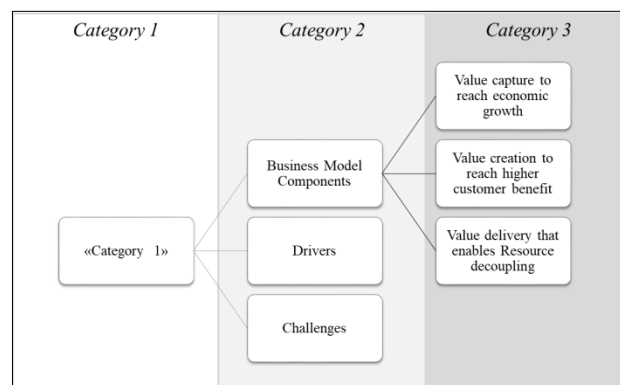


Figure 8. Graphic representation of the process of axial and selecting codifying. Source: Own elaboration

In the process of codifying the interview with the industry experts, *selective coding* consisted in the general categorization into macro-categories (“*category 2*” and “*category 3*”) consistent in general with drivers and challenges of *servitization* and *business model components* with the aim of analysing industry trends and patterns in order to introduce the context in which the firms in the interviewed case studies operates.

The results that emerged from this process are presented in the following chapter, while the all the questions asked in the interviews, the tables used for codifying and the results are reported in the appendixes.

3. Case Studies Presentation and Discussion

This final chapter concerns the presentation of the case studies that were analysed. A summary of the phases of the analysis is presented in *Table 12*.

Table 12. Summary of the phases of the analysis of the results. Source: Own elaboration

Phase #	Stage of the analysis	Content	Subject interviewed
1	Contextualization and presentation of trends in the manufacturing industry	<ul style="list-style-type: none"> • environmental sustainability • servitized business model components • value creation, capture and delivery for reaching environmental sustainability • challenges and drivers for servitization 	Industry expert
2	Analysis of the first case study	<ul style="list-style-type: none"> • firms presentation and environmental sustainability approach; • servitized business model and environmental sustainability • Challenges of PSSs implementation • Drivers of PSSs implementation 	Energys S.r.l.
3	Analysis of the first case study	<ul style="list-style-type: none"> • firms presentation and environmental sustainability approach; • servitized business model and environmental sustainability • Challenges of PSSs implementation • Drivers of PSSs implementation 	Arneg S.p.A.

The first phase of the analysis is dedicated to a contextualization of trends relatively to the manufacturing industry in Italy and presents the results of the interview with the industry experts. While, the other two are dedicated to the presentation of the manufacturing firms that were interviewed and studied. Following a brief presentation of the firms and their approach to environmental sustainability, the results of the analysis are divided into three paragraphs that are based on the research questions presented in *section 2.3.2*³⁰. These are the following:

1. Presentation of the specific servitized *Business Model* and its effects on environmental sustainability;
2. Description of the challenges that emerged during the qualitative analysis of the specific case studies;
3. Definition of the drivers that should be encouraged with the aim of increasing business strategies that are coherent with environmental sustainability.

³⁰ (b) What are the components of Product-Service Systems business models relatively to value creation, capture and delivery?; (c) Do they fulfil the three requirements in order to classify as Circular Economies strategies/environmentally sustainable business approaches?; (d) What are the most frequent challenges that make it difficult for manufacturing firms from implementing such business models?; (e) What are the most frequent drivers that make manufacturing firms decide to implement this type of business model?

3.1 Italian manufacturing industry: Environmental Sustainability and Services

Manufacturing firms are asked to respond more and more to environmental issues such as global warming, plastic pollution and global resource scarcity (Fischer-Kowalski *et al.*, 2011; Masson-Delmotte *et al.*, 2018; WWF, 2018). Companies must change their way of doing business: the need to perform business activities in a way that is environmentally sustainable is as important as it has never been in the past.

This was considered *fundamental* in the brief conversation with sustainability consultancy company *Nativa S.r.l. SB*, that was asked for a feedback on the concept of *environmental sustainability* and relative business approaches³¹. The predominant vision is that changes have become so urgent that a transformation is happening in all industries, even though the timing of these transformations, are different from sector to sector. This is due mainly to the fact that by nature some businesses are concerned with activities that are not environmentally friendly.

Another key topic, that emerged, is that the shift toward environmentally-friendly *Business Models* is driven by the general industry context. Companies must find new models that are able to regenerate the environment, because the old shareholders' paradigm, that has been successful until recent years, is not sustainable anymore. The focus must shift from reaching only one objective, i.e. profits, toward the development of *Business Models* able to reach prosperity of both environmental and economic dimension. The related challenge is then finding this new model that is able to combine the two dimensions. With the aim of presenting a *business model* that combines these two dimensions, this final chapter is aimed at verifying whether *PSSs* can respond to this challenge.

Besides a first presentation of the vision of *Nativa S.r.l. SB*, the rest of chapter discusses the results of the explorative interview that was carried out with the industry expert from *ASAP Service Management Forum*. The aim is to present industry trends regarding the following:

- *reasons why companies in the manufacturing industry approach environmental sustainability*, i.e. presents the aims of companies that decide to approach the environmental issues in the first place;

³¹ *Nativa S.r.l. SB* is a certified Benefit Corporation that operates as consultant with the aim of helping companies in developing and implementing sustainable innovation and in building "Benefit Unit", that are socially and environmentally sustainable by design. Source: (*Nativa S.r.l. SB*, 2019) . Their contribution to this qualitative research was limited for different reasons, but they were helpful in identifying relevant issues in Business model innovation for sustainability, thus part of the answers they were able to give, is reported as an introduction to this section.

- *servitization as a tool for reaching environmentally sustainable goals*, i.e. the reasons why services and servitization are important in this regard;
- *drivers and challenges of servitization* that needs to be, relatively, fostered or overcome in order to implement servitization and foster an environmental approach to business activities.

3.1.1 Environmental sustainability in Italian manufacturing industry

The main environmental sustainability driver for manufacturing firms is economic: environmentally sustainable approaches allow them to reduce costs, increase profit margins (considering stable revenues) and foster economic growth. It emerged, as it resulted from the study of academic literature, that economic sustainability is always necessary. *Environmental sustainability* is driven mainly by the fact that due to global consumption of resources, inputs for business activities are becoming more and more expensive. This is causing a search for alternative inputs that can sometimes result in companies developing reuse and recycling model in order to deal with the problem. In addition to this, environmental *Business Models* foster production efficiency. The substitution of resources with less expensive ones and the increase in production efficiency is able to reduce overall costs of manufacturing firms.

The second reason for approaching greener business practices is marketing. Customers are asking for greener products because of the greater attention given by the media toward problems such as global warming or plastic pollution in the ocean. This is why companies are giving always more and more importance toward communicating how they are approaching problems such as those mentioned above. *Environmental sustainability* becomes an added value for *Original Equipment Manufacturers (OEMs)*. They are interested in showing what practices they are implementing for saving the environment, and this goes back to the beginning of the value chain, resulting in *Original Equipment Suppliers (OESs)* to provide support to *OEMs* through maintenance and operational support services, so that they can prove to customers that they produce products in a sustainable way.

3.1.2 Servitization: A tool for implementing greener business activities

In this context, companies must find the right *Business Model* that allows them to reach *environmental sustainability* while being financially sustainable and reaching their marketing objectives. *Servitization* and the *Product-Service Systems Business Model* emerged as the answer to this quest.

This correlation is being discussed a lot also in the academic literature. In the previous chapters, theoretical considerations were made in order to understand whether *Product-Service Systems* strategies classify as *circular economy strategies or environmentally sustainable approaches*. The result was that in order to do so, they should satisfy three requirements (Pironi, Mcaloone and Pigosso, 2019): *delivering superior customer benefits, reach economic growth and reach resource decoupling objectives*. In this regard, in the qualitative investigation, these three requirements emerged as “design” characteristics of components of integrated *Product-Service Systems BMs* in the manufacturing industry, especially in the B2B context.

Concerning economic growth, in *PSSs Business Model*, companies implement revenue models that allow them to capture increasing customer value and, in particular, to foster economic growth. Profitability increases because service margins are much higher in respect to products margins and revenues are much more stable, because services are sold through periodical fees that are recurring in companies’ fiscal years (e.g. the case of pay-per-use). In this regard, when combined with tangible products in manufacturing companies, services allow reaching economic growth. Thus, one of the most important requirements is satisfied. *Servitization* is a tool able to make *environmental sustainability* financially attractive to companies.

The second requirement is that *PSSs strategies* must deliver added value to the customers. In this regard, it emerged that customers are a key component in servitized *Business Models*. Implementing this type of offerings requires companies to construct different value propositions that create enhanced benefits for customers. They must be carefully segmented with the aim of identifying the most suitable service offerings for creating value for them. This confirms that, again, by design *PSSs* satisfy the requirement of creating superior customer value.

Finally, the last condition that should be satisfied by *Product-Service Systems* is the achievement of *resource decoupling*. Service provision in the context of manufacturing

industry is confirmed to be environmentally friendly because it implements activities that are environmentally sustainable. This happens for two main reasons:

- first of all, *product-service systems* are able to increase the durability of products, thus products are thrown away less often, resulting in a reduction of waste;
- in addition, services combined with product offerings allow companies to reduce the number of products sold, because of higher durability, and as a consequence, it reduces the number of products produced. The result is that the consumption of resources is diminished.

The considerations that emerged and that regard the *PSSs* fulfilment of the three requirements are summarised in *Figure 9*.

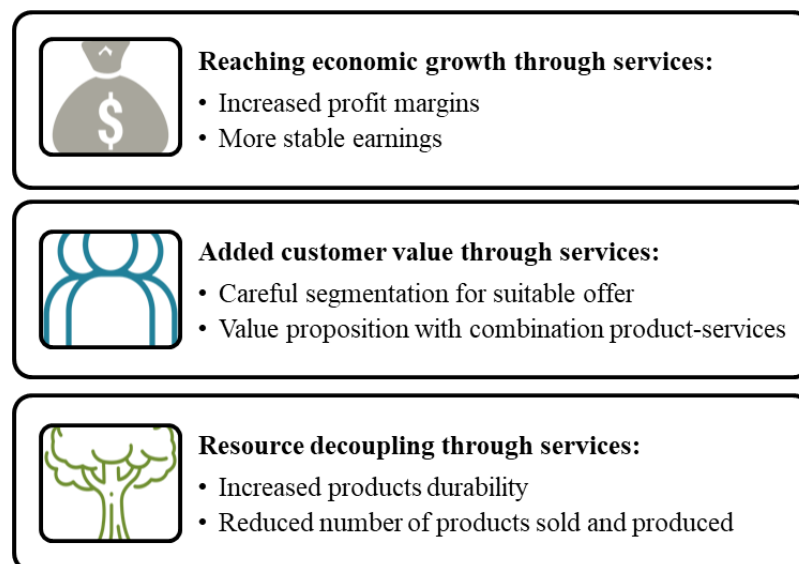


Figure 9. Summary of the results related to the three requirements. Source: Own elaboration

In the theory, networks were presented as a fundamental component of the *Business Model* for service transformation. This element resulted also from the qualitative interview, but while in the theory this was an element presented as a way to deliver the value to customers, on the contrary, in the manufacturing industry this component may have a dual meaning.

- In the academic literature, establishing a partnership is seen as a way to deliver services. Firms and companies are involved in a network that has the aim of implementing a net of focal linkages used for service delivery. This is especially true when the manufacturing firms delivering services are dispersed around the globe. In this regard, networks are seen as a key component for the “value delivery” cluster.

- Firms can exploit the use of partnerships in order to create value for customers. Indeed, companies may use the linkages of a network to gather competencies that are not present inside or that are expensive or take too much time to be developed internally. They search for certain types of competencies (e.g. technologies, technical skills, soft human resources skills) externally with the aim of creating value for customers.

An important result that emerged from the analysis of this study was the unintended environmentally sustainable effect of *Product-Service Systems* (Matschewsky, 2019). Unless, they are particularly motivated companies (i.e. start-ups were presented as examples), it rarely happens that manufacturing firms develop this kind of servitized *Business Model* with environmentally sustainable goals. Despite this, servitization is proven to have all the three requirements to be able to classify as environmentally sustainable. This proves that it is important to act upon challenges and drivers of *servitization*. It is financially sustainable and it drives customer loyalty, but at the same time it is important for implementing something that actually helps the environment and reduces the impact of human activities.

3.1.3 Drivers and challenges of PSSs in the manufacturing industry

When companies in the Italian manufacturing industry decide to implement servitized *Business Models*, they experience challenges that make the path toward their implementation much more difficult or may even force them to abandon this strategy.

In this regard, it emerged that the main difficulties appear to be related to the economic perspective (i.e. summary is presented in *Table 13*) and, in particular, they are related to the lack of experience of companies in service delivery. Indeed, on the one hand, firms find it challenging to establish not only the cost of actually delivering services, but also the costs of initial investments in this sense (i.e. companies tend to underestimate them).

On the other hand, services imply a change in the revenue structure, because sales are not one-shot and there is a need to build a different revenue model. But again, due to the lack of experience in this sense, companies have difficulties in developing structure that they are not used to, especially in the case of firms that have a product-centric mentality.

Table 13. Summary of economic challenges. Source: Own elaboration.

ECONOMIC CHALLENGES	
COST STRUCTURE	REVENUE MODEL
<ul style="list-style-type: none"> • Difficult to develop the right cost structure for services due to lower competencies in predicting investments costs and costs of delivering a service. 	<ul style="list-style-type: none"> • Difficult to develop the appropriate revenue structure for capturing value from services. • Defining a different revenue model is difficult for the lack of experience in services

Even though it is challenging, it comes to light that implementing such *Business Models* delivers relevant strategic benefits to companies: services allows companies to establish a long-lasting and difficult-to imitate competitive advantage. This is fundamental in the Italian manufacturing industry that undergoes a fierce competition with low-cost products and machinery coming from developing countries such as China³². Specifically the strategic drivers that emerged are related to customers' relationship and the possibility of developing differentiation.

In relation to the first driver, service delivery allows companies to develop long-lasting relationship with customers: they install trust and loyalty into clients, because they develop a relationship that is characterized by frequent interactions, through which companies are able to solve problems and provide them a superior value. As far as the second driver is concerned, the possibility of a differentiation strategy in the manufacturing industry is fostered by the basic idea that, while companies search for a competitive advantage through the development of service offerings, services themselves are highly dependent on firms' specific competencies and experience. Each company has its own history, which lead to a specific experience, by which knowledge and competencies are driven. This lead to a personal and specific component of services that creates a lock-in effect: customers are bound to accept a service delivered only by that particular company, because of the firms-specific know-how that is used in delivering spare parts or other services. The strategic drivers emerged in the qualitative search are describes in *Table 14*.

³² Source: <https://www.confindustria.it/home/centro-studi/temi-di-ricerca/tendenze-delle-imprese-e-dei-sistemi-industriali/tutti/dettaglio/rapporto-industria+-italiana+-2019> (Consulted on: 26.01.2020)

Table 14. Summary of strategic drivers. Source: Own elaboration.

STRATEGIC DRIVERS	
CUSTOMER RELATIONSHIP	DIFFERENTIATION ADVANTAGE
<ul style="list-style-type: none"> Services contribute to the development of long-lasting relationship with customers, because they generate loyalty and customer satisfaction. 	<ul style="list-style-type: none"> Specific competencies and experiences of a firm lead to a difficult to imitate component of service offerings. Companies build service offerings to create a competitive advantage. Development of a lock-in effect for customers.

A final consideration regards the frequency by which companies implement servitized *Business Models* of the use-oriented type³³. In the Italian manufacturing industries, companies are keener on the development of product-oriented *Business Models*.

Advanced servitized *Business Models* are difficult to implement, even though firms are trying to develop them in the form of leasing or rent. The reasons that emerged from the interview are mainly related to competitive reasons and are the following:

- Firm performances are different each time and depend on many factors that are not easy to foresee. Thus, providing *Business Models* that correlate payment to measures of machinery/product use of performance is difficult.
- The way in which OEMs use machinery for production is firm-specific and relates to a know-how that is relevant in the development of companies' competitive advantage. Thus, even though companies in the manufacturing industries are less interested in the ownership itself as a value, they are not so much willing to let suppliers run their production machinery for strategic and data protection reasons. Basically, the know-how that is used by *OES'* customers in their production processes, lead to the difficult implementation of use-oriented *Business Models*.

These results are relevant for the present study because they prove that even though the case studies selected for the qualitative investigations do not implement use-oriented or advanced servitized *Business Models*, they are representative of the context of Italian manufacturing industries.

³³ The types of business models refer to the models categories for servitized business models presented by Tukker (2004).

3.2 Energys S.r.l.

This section is dedicated to the presentation of Energys S.r.l., which is the Energy Service Company (i.e. a certified ESCo) of the Piovan Group³⁴ that is a group of companies dedicated to the production of auxiliary automation systems for storage, conveying and processing plastic, polymers and food powders. In order to conduct the qualitative investigation for the present study, the Energy manager of Energys was interviewed. The results are hereby presented.

3.2.1 Energys S.r.l. and environmental sustainability approach

As above mentioned, *Energys* is part of the *Piovan Group*. *Piovan* was created in Padua in 1934 and it started to sell the first auxiliary systems for polymers transformation in 1964. At this time, it became *Piovan S.p.A.* and in 1997 it moved to its current headquarters in Venice. Today it has diversified from the original plastic industry and it has become a group of companies, which produce and sell auxiliary systems that are able to automatize and make more efficient the process of treating and transporting polymers (the original business), recycled plastics and bioplastics, and also food powder.

In general, the *Piovan Group* has a turnover of € 248 million (2018), which is distributed in 3 main lines of business, i.e. *Food* (11,5%), *Plastics* (77,7%) and *Service* (10,8%), which are represented in **Errore. L'origine riferimento non è stata trovata.**. In 2018, *Piovan's* profits were € 25,5 million and they experienced a growth of 26% in respect to 2017. It has a total of 1.044 of employees, which are 508 in Italy and 536 locate abroad in the different production plants that are located in Italy (3 out of 7) and in Germany, United States, Brazil and China (4 out of 7). These information are taken from the sustainability report of the company, i.e. "*Bilancio di Sostenibilità 2018 di Piovan S.p.A.*".

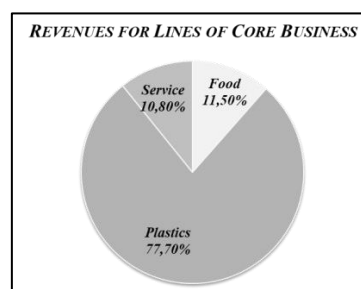


Figure 10. Revenues of Piovan Group. Source: Re-worked version from "*Bilancio di Sostenibilità 2018 di Piovan S.p.A.*"

³⁴ Source: <https://www.piovan.com/en> (Consulted on 26.01.2019)

Since a few years, it is operating also in the industry of industrial refrigeration with a dedicated company and in 2012, *Piovan* and *ESCo Veneto* created *Energys S.r.l.* that operates as a consultant for energy efficiency and energy management in production processes and has two energy managers as employees. *Energys S.r.l.* (which will be later referred to as *Energys*) is a certified *Energy Service Company*, dedicated to deliver energy audit services with the aim of improving energy efficiency for *Piovan* customers and other companies. The methodology implemented by *Energys* is able to give companies access to Italian mechanism of “white certificates” (or Energy efficiency certificates), through which it is possible to certify and give economic value to the customer energy savings³⁵.

Energy auditing and monitoring is fulfilled either through the means of already installed measurement tools (already owned by the customers), or through new tools that are provided by *Energys*, i.e. a monitoring system developed by *Energys* itself that is composed of a software connected to measuring tools that measure different values related to energy consumption. The monitoring system is sold by *Energys* to customers and *Energys* itself support clients from the identification of energy audit needs to the installation and the start of measurement tools that communicate with a *Data manager*. This *Data manager* is able to memorize data and it can be consulted remotely with the aim of visualizing data in real time or historical data. The aim of this software is to fulfil energy audit and develop projects for reducing the costs of energy.

As it emerged both from the sustainability reporting and the interview with the Energy manager, *Piovan*'s current approach to *environmental sustainability* is focused on two main strategies that concerns relatively both physical products and energy services delivery. In particular, these are:

- As far as machinery is concerned, *Piovan* is focused on developing new technologies that permit customers (which are mainly *OEMs* that produce plastics) to transform re-used plastics (e.g. post-consumer plastics). In the life-cycle of plastic products, *Piovan* is positioned in the supply chain as a supplier of machinery for conveying, transforming and transposing post-consumer plastics.
- Relatively to energy services *Piovan* is focused on reducing energy consumption and waste through the delivery of operational support services by the means of the *ESCo Energys S.r.l.* that is aimed at giving advices on energy savings related to production

³⁵ Source: <https://energys.piovan.com/it> – Consulted on 26.01.2019

processes or other types of consumption. These services are offered both to *Piovan* customers and to other companies, having a possibly transverse application.

The focus of this study is the analysis of the service strategy of this company. In the following section, the service strategy will be analysed. Precisely the objective is to extract the features of *Energys*' service in order to prove their contribution to environmental sustainability and the impact of servitized *Business Models* to this issue. If the three requirements (*Pieroni, Mcaloone and Pigozzo, 2019*) are proven to be respected, then it becomes relevant to act upon the challenges and drivers of this *Business Model*, that are presented in the other section.

3.2.2 Product-service systems as environmentally sustainable strategies

Piovan has been approaching services by creating a service dedicated company, which is *Energys*. The service strategy that is implemented and delivered by this firm is configured as product-oriented according to *Tukker's PSSs* classification. This is due to the fact that *Piovan Business Model* consists of selling the ownership of its auxiliary systems and *Energys* is concerned with the delivery of energy services to *Piovan's customers* or to other *OEMs* that are not directly its clients.

In academic literature, *environmental sustainability* calls for *Business Model* innovation, and as this study is trying to prove, it leads, voluntarily or not, to servitized *Business Models* innovation. *Energys* could be considered the “*circular economy strategy*” of *Piovan*: this emerged both from the qualitative investigation and from the content of the sustainability report of the company. In this regard, the two explorative interviews with *Energys*' Energy Manager and the subsequent analysis were relevant in order to identify and label the various components of the firm's servitized *Business Model*. These were then grouped in order to verify the three requirements for *circular economies strategies/environmental sustainability*.

In addition, it should be highlighted that in the present case study energy services were not developed with the aim of reducing *Piovan's* customers' environmental impact, even though this is one of the consequences. Their implementation was mainly driven by the possibility of exploiting legal incentives and promote economic growth in the company. Environmental sustainability is an unintended effect of the service strategy (*Matschewsky, 2019*).

It is to be noted that the case of *Energys* is different in respect to the following case study, because the parent company (i.e. *Piovan*) has developed this type of energy services since

2012, but the Energy manager would like to enhance the offerings to a more service-oriented one by delivering a data based operational support to the customer. Thus, the analysis takes into consideration both the future possible *PSSs Business Model* of *Energys* and the current one.

Value Capture to Reach Economic Growth

In relation to cost structure and revenue model of *Energys*, there is a need for distinguishing between current and future servitized *Business Model*. Capturing value allows company gathering profits and margins, but while for the current *Business Model* the economic growth is proved by actual profits, the future *Business Model* has not yet been implement, though it cannot be used as a confirmation of this first requirement.

As far as the current *Business Model* is concerned, this has proved to be highly financially sustainable and able to deliver an economic growth to *Energys*, and *Piovan Group*: in 3 years *Energys' EBITDA* went from an € 5.000 to € 180.000. A further prove that the *Business Model* is financially sustainable is the relevant impact of services in *Piovan Group* turnover (e.g. maintenance count almost for 20% of turnover). This value is captured through the specific *revenue models* of the *Energy Service Companies (ESCO)*, which use a structure of revenues driven by the energy savings of the customer: thanks to the improvement of energy management, they are able to save money and these economic savings are divided between *Energys (ESCO)* and the client.

The future revenue model and the costs level relatively to the implementation and the resources for this *BM* is possibly economically and financially sustainable (as far as the business plan is concerned) thanks to the contribution of external partners that assisted the Energy manager in developing a sustainable economic plan, proving that ideally it could be financially sustainable. The idea is to structure the monetization and revenue dividing income into two main streams:

- One –shot sales for the customization of the architecture of the software that is developed for the specific need of the customer;
- Periodical fee for granting access and updates and for a specific support service offering.

The *Business Model* in its current form is able to deliver economic growth for *Energys* as it is proved by the exponential and rapid growth of the *EBIDTA*. On the other hand, besides what emerged from the interview, the economic sustainability of the enhanced revenue model

cannot be proved because it has not been yet implemented, but it has only been proposed by the Energy manager (red sentences in *Table 15*).

Table 15. Summary of components for capturing value and fostering Economic growth. Source: Own elaboration

ECONOMIC GROWTH	
ECONOMIC SUSTAINABILITY	STRUCTURE OF THE REVENUE MODEL
<ul style="list-style-type: none"> • Growing EBITDA of the company (€ 5.000 - € 180.000) • Relevant impact of services in the Piovan's turnovers • Development of a realistic profit plan for future enhanced service offering through co-operations and partnerships 	<ul style="list-style-type: none"> • Typical revenue model of ESCo • Division of economic savings between Energys and the end customer • Two different streams of income: one-shot sale for the customization of the architecture; periodical fee for access/updates or data analysis

Value Creation to achieve Superior Customer Value

This second cluster is aimed at proving how *Piovan* can create value and deliver superior value to its customers through energy service offerings. From the analysis, it emerged that the value creation objective is achieved by the means of 4 main components, which are: *customers, resources use for the Business Model development; value proposition as a bundle of product and services, networks creation.*

Table 16. Summary of Value Creation component for creating Superior Customer Value. Source: Own elaboration

SUPERIOR CUSTOMER VALUE			
CUSTOMERS	RESOURCES FOR BM	VALUE PROPOSITION	NETWORKS FOR CREATING VALUE
<ul style="list-style-type: none"> • Customers value technologies and I.o.T sensors • Principal customer segment deal with plastic production • Customer enhanced benefits from information provision, environmentally sustainable processes • Customers relationship must be managed carefully for strategic issues related to production processes 	<ul style="list-style-type: none"> • Availability of financial resources • High installed base • Highly skilled human resources • Technologies, I.o.T and various ICT tools 	<ul style="list-style-type: none"> • Environmentally sustainable value proposition • Enhances support services based on data analysis and data management • Energy efficiency services • Traditional auxiliary systems product offering 	<ul style="list-style-type: none"> • Enabling technological development through partnerships

As far as customers are concerned, *Piovan's* clients are mainly concerned with plastic production, which lead to a need of managing energy efficiently since the costs driven by energy consumption are a relevant portion inside customers' bills and total costs. This creates a need for them, that are usually not able or interested in managing directly those costs. This particular feature of *Piovan* customer segment allows *Energys* to take away a problem for customers creating superior value for them.

In addition to this feature, *Energys'* services deliver value to customers because they deliver support services in managing machines functioning (customers are asking to the Energy manager these type of services). These pieces of information allow customers to increase efficiency in energy consumption and waste, whose costs are very high as previously mentioned. Customers can develop data-driven proves that their processes are *environmentally sustainable* which is a competitive advantage for *Piovan's* customers, that can certify that their own products are produced in an *environmentally sustainable* way.

Finally, there is a warning element in this component: it is important that *Energys* manage customers' relationship in a clever way, because by delivering services they may manage data that are strategic, especially if concerned with production processes, as the Energy manager would like to do. On the other hand, delivering energy efficiency services is easier because customers are not interested in keeping that data inside, because they do not have a strategic purpose or function.

Moving to resources, they are here presented as the tangible and intangible elements that *Energys* uses for its current *Business Model* and that is planning to use to deliver its enhanced support services. *Energys* resources for service offerings are the following:

- *Availability of financial resources: Piovan Group* high turnover allows *Energys* to access financial resources that are fundamental for services innovation and new *Business Model* development;
- *Installed Base: Piovan* has a high number of product sold and currently functioning that can be exploited for delivering services;
- *Highly skilled human resources:* this is a resource that is currently lacking in *Energys*. The energy manager is experiencing difficulties in service delivery due to this issue, because the current human resources are an obstacle for service growth. The goal is to acquire dedicated human resources capable of selling a service. Besides these, for the future value proposition the firm should hire resources with competencies related to non-energy data that are currently lacking.
- *Technological resources used for services development:* the monitoring software development and new technological development in general give the possibility to enhance the current energy services but also to develop new services such as the operational support through data analysis, machines proactive maintenance, etc.

The last component is the value proposition, which is the most important element that allows creating value for clients. As already mentioned Energys is part of Piovan Group, whose value proposition is concerned with offering auxiliary and production systems for plastic and food industry and industrial refrigeration. The ownership of products is passed to customers that employ these machines in their production processes. On the other hand *Energys* delivers superior value to customers, because it is specifically dedicated and concerned with service delivery and problem solving for customers. First of all, its value proposition is environmentally sustainable because its energy services allow customers to reduce their environmental footprint. In addition, being completely focus on service offerings it has the possibility of enhancing even more its value proposition by delivering services that are based on data management and analysis, i.e. process oriented services that are able to increase production efficiency for customers.

Partnerships and co-operations are sometimes used differently from the framework presented by *Reim et al.* (2017). Indeed, networks may be exploited for enabling value creations, especially in the case of highly technological products. In these circumstances, the energy manager is exploiting its external co-operations in order to develop the new enhanced servitized *Business Model*: she is searching for already developed technology, knowledge and skills. These are lacking internally, not because employees do not have the skills to develop them, but because the timing and costs needed to develop the knowledge and technologies are prohibitive and would increase time-to-market of the services. They would result in *Energys* employing resources in *R&D processes* for something that already exists outside and that they can use as a starting point for service delivery. Developing the structure for service delivery is what *Energys* should focus on, because this component represents the fundamental element of competitive advantage.

Given the components of *Energys' Business Model*, the result is that service is not only able to create value, but it is able to deliver a value that is enhanced in respect to the situation of a product-centric *Business Model*, where there is a lack toward customer's problems and needs.

Value delivery for reaching Resource Decoupling

The structure through which services are being delivered in this case study is t a dedicated company, which is *Energys*. *Piovan* is selling the physical products (the auxiliary systems) and *Energys* is selling energy services by the means of its employees (i.e. the energy manager and another employee that is more operative). This particular structure classifies as differentiation in the *ambidexterity context* (*Raisch et al.*, 2009) and it represents the

companies approach to *PSSs offering*: this is the structure that the company created for service delivery.

As it has been theorized in the study by *Kjaer et al. (2018)* resource decoupling is achieved through services by the means of 4 enablers: *operational efficiency, product longevity, intensified product usage* and *product system substitutions*. In *Energys* there are differences between what the company is currently achieving and what the company may achieve in the future, if the *Business Model* that the energy manager would like to propose is accepted.

First of all, in terms of current servitized offer the company is now able to enable relative *resource decoupling* in the form of a *reduction of the need for resources during product use* and in the form of a *displacement of more resource intensive systems*. This is achieved because the service strategies delivered by *Energys* enable *operational efficiency* and *product-system substitution*. In particular the *ESCo* is currently delivering services for monitoring the energy consumption of machines that are employed in the plastic production processes. *Energys* is able to improve and increase energy efficiency and at the same time, reduce energy consumption for customers leading to a reduction in the level of resources that are used during production machines or auxiliary systems. In addition, as *Energys* is an *ESCo* and operates with *optimized result* strategies. This leads to the achievement of *product system substitutions* at the product level, because there is an incentive for customers to substitute their production machines with more efficient ones that are less resource intensive (i.e. in this way they obtain the energy efficiency certificate and receive an economic incentive).

In term of a possible future service strategies (red sentences in *Table 17*), it should be clarified these *relative resource reduction effects* are only a possibility, but they are anyway important in order to clarify how services can contribute to environmental sustainability. The service that the Energy manager would like to deliver is related to proactive and preventive maintenance and a more advanced form of operational support that wouldn't be strictly related to energy consumption. This would be both based on data management and analysis able to correlate technical data of machines to economic costs or other relevant KPIs. The customers would be able to achieve operational efficiency, but also to increase longevity of the machines used in the production processes. This would lead to a diminished need for auxiliary systems production.

Current and future service strategies allow achieving all the three relative resource reduction aims proving that services do actually have all the characteristics needed for reducing the impact of business activities on the environment. It is anyway difficult to present a detailed

analysis for reaching *absolute resource decoupling* due to lack of information and data. But for the purpose of this study, the relevant result is that when *Energys* will develop this last *maintenance service*, the company will actually be able to achieve all three aims of relative *resource decoupling* and the service strategy could classify as a *circular economy strategy*. As the service strategy is currently configured, *Energys* is anyway able to impact the effect of its customers on the environment.

A summary of the strategies for delivering value through services is presented in *Table 17*.

Table 17. Summary of Value Delivery components for achieving resource decoupling. Source: Own elaboration

RESOURCE DECOUPLING		
PRODUCT MAINTENANCE	OPERATIONAL SUPPORT	OPTIMIZED RESULT
<ul style="list-style-type: none"> • Delivering an analysis service of the machine based on the data coming from it 	<ul style="list-style-type: none"> • Machine monitoring for energy efficiency improvements • Energy efficiency management service to save on energy consumption • Upgrading of the current service on energy efficiency management service • Data analysis and correlations for providing qualitative support services 	<ul style="list-style-type: none"> • Result-oriented services are typical of energy service company, where the economic return is directly proportional to how much the machine is efficient

Proven that *Energys*' service strategy fulfils the requirements for being classified as an *environmental sustainability* approach, the following two sections are dedicated to the explanation of challenges that need to be overcome or drivers that need to be incentivised, in order to increase the implementation of these types of *Business Model*.

3.2.3 Challenges of Product-service Systems adoption

This section is concerned with the identification of challenges that *Energys* and, specifically, the Energy manager is experiencing in the process of implementing a servitized *Business Model*. In this case study, challenges were particularly relevant since the Energy manager is currently try to implement a new enhanced service and in this regard is facing some challenges that are mainly due to *Piovan* organizational culture, which is too focused to produce and sell tangible products, i.e. the auxiliary systems.

From the qualitative interviews, the challenges that emerged were clustered into 4 main groups according to their nature. These categories are the following:

- *Economic*: the *traditional product business is highly profitable*, thus there are no incentives to focus on service innovation and/or for developing well-organized after-sales services. Even with the aim of growing the current service offerings, the business is still operating at its minimum because sales managers do not have high enough economic incentives for selling services.
- *Organizational Culture*: *Piovan* is a manufacturing company that sells physical products since 60 years. It has a product-centric mindset, that lead to a problematic development of *Energys* service offerings, and also to the non-exploitation of the business opportunities. *Energys* is facing difficulties both in the growth of the current service and in the implementation of the new one. This is happening because the product-centric mindset is very much diffused in *Piovan*; especially in the regard of the proposal for a completely new service, there is a fear of the possibility of a cannibalization effect between the old service and the new one. Another problem is driven by *Energys* dimensions (*Energys* has only 2 employees) in respect to *Piovan*. This makes it even more harder to overcome the culture of the parent company, which lead to the fact that even in the case *Piovan*'s supervision software, which could be exploited for service delivery, is instead sold a product.

Finally, human resources are the most relevant element in selling a service. They are the ones that face the customer. The success of the offering depends on their ability to convince them, but *Energys* does not have the needed skilled resources, because it should count on *Piovan*'s sales manager that are not selling its services because they lack knowledge and are not confident enough to sell them because they are afraid of losing the customer.

- *Organizational Structure*: the current structure of the firms is actually another challenge for the implementation of a *PSS*. This is mainly because services do not follow a clear path: *Energys* is the service company for *Piovan*'s energy services, but *Piovan* is willing to develop a new aftersales (due to shareholders request) that will be part of a different division (maybe even a different firm of the group). Furthermore, *Energys* has only two employees, at the time of the follow up, and only one now (i.e. the Energy manager), and should count on *Piovan*'s sales manager to sell the services that are not selling them due to the organizational culture problem that was mentioned above. As consequence, *Energys* and the service offering is not growing at its full possibilities because its lacks people that are able and incentivized to sell something that is different from traditional

physical product. Finally, there is another problem which is due to the fact that other companies would like to acquire Energys as a company and incorporated it into their business, which would undermine the firm’s independence and ability to deliver a service transversally to different customers.

- **Strategic:** the first and most relevant challenge of strategic nature for *Energys* is the fact that *Piovan*’s auxiliary systems have a lock-in effect to customers’ processes due to their characteristics. They are so invasive of customers’ processes that when there is a problem, the customer is forced to confront *Piovan* itself. This lead to a lack of incentive for innovating its *Business Model* in terms of after-sales services. Then, in terms of Internet of Things and Data management, *Piovan* is not moving as fast as their competitors, which are stealing some business opportunities in this sense. Finally the issue of data management, due to privacy and competition they didn’t understand the customers’ needs for data management or data based services, which lead to losing some business opportunities.

Table 18. Summary of challenges to PSSs implementation. Source: Own elaboration

CHALLENGES			
ECONOMIC	ORGANIZATIONAL CULTURE	ORGANIZATIONAL STRUCTURE	STRATEGIC
<ul style="list-style-type: none"> • Lack of effective economic incentives for service growth in <i>Piovan</i> • Lack of incentive to service innovation due to highly profitable traditional product business 	<ul style="list-style-type: none"> • Product-centric organizational culture • Small dimension of Energys inside <i>Piovan</i> group • Fear of cannibalization of the new services with the existing software offering • Need for development of new competencies to deliver a service 	<ul style="list-style-type: none"> • Lack of a well-organized after-sales service • Possibility of acquisition by another company of the group • Acquisition of external human resources capable of selling a service 	<ul style="list-style-type: none"> • Competitors are moving faster than <i>Piovan</i> • Inability to understand customer changing need • Lock-in effect resulting in organizational resistance to innovation

3.2.4 Drivers for Product-service Systems adoption

The qualitative analysis of the present case study highlighted also some drivers that were the initial reasons why Energys was created, thus that fostered the implementation of services in a manufacturing company and that now are the incentives for the Energy manager in the aim of developing a new enhanced PSSs that is comprehensive also a maintenance product strategy based on data analysis and data management. These drivers were grouped into 5 groups:

- *Economic:* as it was often mentioned above, service delivers high margins and revenues for the company. This is an incentive for keeping these services because they are economically successful and contribute to the financial health of the *Piovan Group*.
- *Legal:* *Energys* itself was born to answer to a legislative incentive that is being given to companies that are able to prove that the machines they employ in production processes are more efficient than others. Fiscal incentives should be fostered. In this particular case, legal incentives were useful twice: first in their ability to induce *Piovan* to develop a service offering and in its efficacy in providing an incentive to enhance software technologies that could be exploited as a base for service development.
- *Strategic:* customers are increasingly concern with environmentally sustainable problems. OEMs must be able to answer by proving that their products are more environmentally sustainable than others, both in production or in the input that they are made of. Services like the ones that *Energys* delivers to *OEMs* are a mean to achieve this same goal. *OEMs* through the means of services delivered by *OESs* are able to prove and certify to the final customer their green activities or environmentally sustainable products. In addition to this, relatively to *OEMs*, they are willing to externalize the management of energy data, which is a business opportunity for *Energys*. This is especially true, even though it has not been implemented in *Energys*, when the customer who asks for a particular maintenance that is currently lacking in the firm or operational support service is a lead user. In the future, *Energys* may want to follow its request and develop a new service related to this. Finally services are a way to develop customer loyalty because of the personal and relational component of this kind of offerings. While the company cannot sell you anymore auxiliary systems because the client already has one, it is a way to increase and develop customer loyalty and, thus, retain them in the perspective of a future purchase of another auxiliary system.
- *Technological:* technologies and technological development through tools such as I.o.T. increase the possibility of data management on how machinery works in the production processes and which is their current state. It allows *OES* such as *Energys* to provide services that allow increasing production efficiency (who better than the company who produces the system knows which is the better way to use the system

itself?). All the data that can be gathered through the supervision software or the monitoring systems for customers give *OESs* the needed tools for delivering *PSSs*. Technological innovation in services is as mentioned before a resource, but also a drivers because the customers themselves are asking Energys to have access to new technologies and related services. And as it happened to the Energy manager their refusal or lack of such technologies force the customer to go to a competitor that has already developed that same offer.

Table 19. Summary of drivers for *PSSs* implementation. Source: Own elaboration

DRIVERS			
ECONOMIC	LEGAL	STRATEGIC	TECHNOLOGICAL
<ul style="list-style-type: none"> • Economic growth through high profit margins and revenues 	<ul style="list-style-type: none"> • Fiscal incentive to increase energy efficiency • Technological upgrade of the software in order to meet the law requirements 	<ul style="list-style-type: none"> • Customer demand for environmental sustainability • Demand for technologies able to analyse data • Demand for handling externally the analysis of energy data • Service development through a lead user • Development of customer loyalty through service delivery 	<ul style="list-style-type: none"> • Implementation of sensors and measurement instruments for • High number of data gathered by sensors which represent an unexploited resource

3.3 Arneg S.p.A.

This last section is dedicated to the presentation and discussion of Arneg S.p.A.³⁶, which is a company that deals with the design, production and complete installation of complete equipment for retail sectors, in particular, supermarkets and shops. As in the previous case study, in order to conduct the qualitative investigation, the Energy manager of Arneg was interviewed. The results that emerged are hereby presented.

3.3.1 Arneg S.p.A. and environmental sustainability approach

Arneg S.p.A. (which will refer to as *Arneg*) is an Italian manufacturing company that was founded in Padua in 1963. It deals mainly with the design, production and installation of various tools for retails and refrigerated aisle (almost 130.000 every year) or sections. Its products are famously recognized for their high performance, their environmentally sustainable characteristics, such as increased efficiency of energy savings and for their “made in Italy” design. Their customers are all the most relevant GDO groups in Italy.

Arneg is the parent company of a group that is distributed worldwide with 20 production sites and 13 commercial offices that are located abroad. In particular, the firm is operating all over Europe, in Africa, in North America and South America and in Asia, where it has developed a strong presence in Korea. As far as Italy is concerned, *Arneg* is part of a group that counts other three firms³⁷ that are the following:

- *Oscartielle*, that produces refrigeration aisles and solutions for highly specialized shops and supermarkets;
- *Incold*, that is concerned with the production of refrigerator cells for commercials or industrial use;
- *Intrac*, that operates in the small, medium and large distribution and offers a wide and diversified range of products from shelves to checkout counters.

Arneg operates with a great attention to customers’ needs and problems, presenting itself as a problem solver for them and has evolved over the years driven by this attention toward clients’ needs and the evolution of information technology tools (especially following Internet

³⁶ Source: <https://www.arneg.it/it/azienda/chi-siamo> (Consulted on 30.01.2019)

³⁷ Source: <https://www.arneg.it/it/arneg-world/le-origini-italiane> (Consulted on 30.01.2019)

of Things tools). The objective of the firm is to reach economic growth combined with environmental sustainability and respect for the environment and delivery of superior value to its customers³⁸.

Arneg has its headquarters in Campo San Martino (Padua). In 2018, had a turnover of 252 million €, with an EBIDTA of almost 20 million euros and it counts a number of 696 employees³⁹. Both revenues and employees have remained stable from 2018, even though the turnover, and also the EBITDA, has experience a small growth⁴⁰. Due to its success over the years, *Arneg* has developed since 10 years a successful service offering that has the aim of developing loyal and trustful relationship with customers. Service offerings are delivered internally and in ten years, it has gone from being worth 1/15 to 1/3 of the company's turnover⁴¹.

Arneg's product-service offering was developed with the aim of enhancing the warranty offering for clients: warranty only lasts a few years, while it take from 10 to 15 years to substitute a refrigeration aisle. This lead to the idea of implementing a well-structured service offering, which is managed by a division internal to *Arneg S.p.A.* Indeed, service in *Arneg* counts many employees that are concerned with solving customer problems. In particular, there are 15 Area managers, 30 specialised and operative technicians, 40 people that operate in the monitoring office, 200 qualified assistance centres, who deals with more than 1 thousand stores that are handled in remote monitoring and more than 6.000 stores that are assisted.

Its offering consists of a traditional post-sales service aimed at maintaining a high level performance of the refrigeration aisles and other products all over their life cycle (i.e. maintenance and optimization services) and also of a consultancy service to customers that allows them to efficiently plan their business strategies. According to the company policy giving the highest focus to the customer, services have the aim of optimizing and increasing efficiency of stores and refrigeration aisles thanks to advising services and to the exploitation of the latest technologies available on the market. In particular, *Arneg* has developed a service of remote monitoring of alarms and periodical maintenance and in addition to this it has developed *IRIS* and *IRIS ENERGY* that are used to efficiently managing the customer store

³⁸ Source: <https://www.arneg.it/it/azienda/codice-etico> (consulted on 30.01.2020)

³⁹ Source: Aida database (consulted on 30.01.2020)

⁴⁰ Source: Aida database (consulted on 30.01.2020)

⁴¹ Source: <https://www.industry4business.it/servitization/arneg-non-solo-banchi-frigo-ecco-le-opportunita-digitali-della-servitization/> (consulted on 30.01.2020)

through personalised technical maintenance and services for optimizing energy consumption that allows to ensure relevant economic savings and are part of *Arneg's* approach to *environmental sustainability*⁴².

IRIS (Interactive Remote Information System) is a web management system that represents an innovative technological support aimed at controlling in real time the whole stores. In particular, *IRIS ENERGY* deals with the optimization and efficiency of energy utilization with personalised and focused measures that allows to save energy and economic resources. This service deals not only with energy consumption of refrigeration aisles, instead it handles also energy utilization the whole store that is not due to *Arneg's* product such as lighting and air conditioning. This means that all macro consumptions are managed by one monitoring point that is able to collect data and develop a reporting service that operates as an external technical office for their customers⁴³.

Besides this, *Arneg* has currently developed an assistance service for the customer that is active 24/24h and that deals with all problems that customers encounter with handling a supermarket regarding not only refrigeration sections but every tools that may not be working in the supermarket. This service is called "*Chiamate extra freddo*", but its details and development are outside the purpose of this study.

Arneg's approach to environmental sustainability is mainly customer driven as it has been confirmed both by the qualitative investigation with the Energy manager and by the triangulation with company's website and articles related to company's service strategy. Once again, as in Energys' case study, the company's approach to environmental sustainability is linked to both products features and energy services. In particular, the firm has created the program "*Naturally innovative*" with the aim of involving its customers in their aim of reducing their impact on the environment. Their philosophy in this sense is represented by two main brands:

- the "*Beeinvironment*", which concerns the high energy efficiency and low environmental impact of the refrigerated cabinets. *Arneg* has developed over the years products that are highly efficient and whose impact on the environment is lower than ever. They have specifically developed a product line that is characterised by technological solutions that allow a fast return on investments thanks to energy services.

⁴² Source: <https://www.arneg.it/it/service/un-evoluto-concetto-di-assistenza> (Consulted on 30.01.2020)

⁴³ Source: <https://www.industry4business.it/servitization/arneg-non-solo-banchi-frigo-ecco-le-opportunita-digitali-della-servitization/> (Consulted on 30.01.2020)

- the “*Beenergy*”, which concerns with technologies and services that aim at reducing and optimizing energy consumption. In particular, in this sense the company has developed a service offering that deals with remote monitoring for the energy management and predictive maintenance for stores.

As in the previous case, the focus of this study is on the second “*Beenergy*” approach of the company because it aims at investigating the impact of the service strategy on the environment. As a consequence, in the following section, services will be analysed with the aim of answering the particular research questions of the present study. The aim is to extract features of the service offering that proves their contribution to environmental sustainability and the impact of servitized *Business Models* to these issues. In case the three requirements needed (Pironi, Mcaloone and Pigosso, 2019) are proven to be respected, it is important to work on the challenges and drivers of this *Business Model*, that are presented in the last sections.

3.3.2 Product-service systems as environmentally sustainable strategies

Arneg has been approaching the development of a *Product-Service System Business Model* with the ambidextrous strategy of integration (Raisch et al., 2009), because the company has developed its services internally without creating a new company, as Piovan did, and exploiting the name and brand reputation of Arneg. As far as services *Business Model* classification, Arneg’s approach is similar to the one used in Piovan, because PSS have are product-oriented. Again, the ownership of products is sold to customers and Arneg delivers services on those products (the refrigerated cabinets) or other products, whose property is always of the customer.

The firm is approaching environmental sustainability through the “*Naturally innovative*” programme which has the aim of reducing energy consumption and protecting the environment. This program is comprehensive of the *Beenergy services*. These services have the objective of foreseeing energy consumption, preventing problems and optimizing energy wastes with the aim of reducing the related costs. As previously explained, the company has been developing this offering through the means of technological tools that allows the remote monitoring of the stores. In particular, with the co-operation of external companies that developed the hardware, the firm has implemented the *IRIS Energy management system* that is the main tool used for reducing customers’ environmental foot print. *IRIS Energy* allows

supervising and monitoring customers' stores and the relative assistance and maintenance measures, energy consumption, remote monitoring activities and the economic savings obtained by the company. This service can be performed even in stores that do not have *Arneg's* products and delivers activities such as retrofit, lighting management and integrated management of consumption and building automation.

In the environmentally sustainable perspective, *Arneg* has innovated the traditional product-centric *Business Model* based on one-shot sales and has transform it to a product-service systems, that through the means of services, especially the energy management services is able to deliver business strategies that are environmentally sustainable. It is important to note that as in the previous case study, it emerged from the interview, that despite their presentation as environmentally sustainable in the company's website these services were not implemented with the objective of being environmentally sustainable, but with the aim of solving a customer problems. *Environmental sustainability* is unintended (*Matschewsky*, 2019).

The following sections are concerned with presenting the results of the qualitative investigation that is driven by the interview to the Energy manager. The content of the interview has been coded and sentences have been grouped to identify the *Business Model* components of *Arneg's* services offerings. The components are presented in the three clusters presented in the previous chapter with the aim of proving the fulfilment of the three requirements for proving environmental sustainability of *Arneg PSSs offerings*.

Value Capture to Reach Economic Growth

In the *Arneg's* case study, the financial sustainability of the servitized *Business Model* is proved from what emerged from the investigation of the interview with the Energy manager.

First of all, the company's turnover is due for 1/3 by service division revenues, thanks to the impressive growth of service revenues: in 10 years, they became 9 times higher. This result is even more relevant when compared to product's revenues that were only doubled in 10 years (from 2009 to 2018, they grew from 150 million € to 250 million €⁴⁴). In addition, services value for customers contribute to increase the company turnover: services allow developing loyal relationship with customers, because thanks to services when they need to change a refrigerated cabinet, the first one they ask to, is *Arneg* itself.

⁴⁴ Source: Aida database (consulted on 30.01.2020)

In order to achieve these results, services are delivered to customers through clear and very detailed contracts. The monetization structure of the offerings is based on the *IRIS Energy management system* being given for free to customers (supermarkets have the access for free to the software, so that they can check *Arneg's* activities whenever they want), while services are sold at a periodical fee.

A summary of these components is presented in the following table.

Table 20. Summary of value capture component in *Arneg* to reach economic growth. Source: Own elaboration

ECONOMIC GROWTH	
ECONOMIC SUSTAINABILITY	STRUCTURE OF THE REVENUE MODEL
<ul style="list-style-type: none"> • Growing turnover of the service division (9 times higher in 10 years) • Services turnover is the 1/3 of the company's overall turnover • Service turnover is growing faster than product business • Services increase overall company financial sustainability 	<ul style="list-style-type: none"> • <i>Arneg's</i> values proposition is sold at very high price due to the service component • <i>Arneg</i> charge a periodical fee for service delivery, while the software is given to customers for free

With the results that emerged from the qualitative investigations the economic growth requirement is fulfilled. There is a lack in official data in respect to *Energys*, because service is handled by a company's division that does not have a balance sheet. Despite this, the content of the interview and the answer of the Energy manager confirmed that not only economic positive results for services are growing, but also they contribute substantially to the company result.

Value Creation to achieve Superior Customer Value

The first element to deliver value to customers is the value proposition. For *Arneg*, this is a combination of traditional high quality, customer-driven physical products (i.e. the refrigerated counters, supermarkets shelves, refrigerator centres) and services. In after-sales service, spare parts count for a minimum part, while the rest consists in customer assistance, where the customer has superior value because *Arneg* is able, through service delivery, to become a consultant for them.

In *Arneg's* case, this requirement is fulfilled by their continuous customer approach. Their service offering was developed initially based on a customer request, and then, that same project was implemented with the aim of delivering benefits and advantages to other customers. Customers are a relevant component in this cluster. Stores and supermarkets are *Arneg's* customers: they are the ones driving service offerings innovation. Their requests and

their needs are exploited for creating value in *Arneg*, who is able to create value by managing their relationship in a way that increase trusts and loyalty. This is achieved

- by giving them free access to the software, where they can control what *Arneg* is doing;
- by using clear and detailed contractual relationships;
- by dividing operational risks of supermarkets with them.

The clear approach in service strategy inside the company is a plus for customers, that are usually convinced of the how much *Arneg's* services are worth by data driven demonstration on the level of their overconsumption that gives them an idea, of how much they will save by exploiting the specific monitoring service.

Finally, *Arneg* is operating worldwide and has commercial offices and production site all over the world. Delivering a service is valuable for customers that are far from *Arneg's* headquarters, because it allows supermarkets located all over the world have direct contacts and develop a relationship with the parent company, know their culture and how they operate. Thus, develop higher loyalty and trust for the company.

In order to create value through its servitized *Business Model*, *Arneg* is exploiting the following resources:

- *Data* that are gathered from technological tools implemented in order to deliver current services. Indeed, this data that are collected from remote monitoring and assistance services and they represent the most relevant source for servitized *Business Model* innovation. This is the main reason why services are delivered internally and at the same time the main source of service innovation: through this data the firm gathers knowledge about customers' problems and can propose the right solution at the right time.
- *Arneg's installed base*: as previously mentioned, the company sells every year more than 130.000 refrigerated cabinets. This leads to the conclusion that its installed base is very numerous and this can be exploited by the service division in order to gather data, but most of all it is an excuse for service deliver, because *Arneg* is the one who built the product, they know it and, thus they are the most qualified to advice supermarkets on how to used them, to repair them, or to prevent them from breaking and to tell them how to be more efficient in their use.

- *Technologies*: I.o.T and sensors allow *Arneg* to control and monitor refrigeration conditions, which is fundamental for food conservation and preservation, and it allows gathering data in this regard. Through the software the company is able to normalize them and deliver a valuable service to customers, thanks to remote management, which reduce the risk of not monitoring refrigeration conditions.
- *Human resources*: *Arneg* has a very large service delivery network that is internal to the company and completely dedicated to service delivery, differently from *Piovan*. This is an important resource because it gives them the right focus on the goal of delivering services and they are not distracted by the higher incentives for selling products and they are able to develop the right knowledge and competencies in order to be able to convince customers. These service-focused human resources in *Arneg* are the *Key account service managers*. Through their knowledge and experience *Arneg* is able to always enhance their offerings and increase customer loyalty.
- *Customers* are a key resource for *Arneg's Business Model*, because the firm is so customer oriented that they use their requests in order to develop new services that are then proposed to other customers.

Concerning the value creation for reaching superior customer value a key component has emerged, that was not present in *Piovan Business Model*, that is *Arneg's* ability to take on customers' operational risks (Reim *et al.*, 2017). In particular, the relationship is based on the fact that *Arneg* takes on the risk of operational failure due to the problem of "*Lack of cold*", that forces the supermarket to a continuous monitoring of freezer temperature and in case of happening could have legal consequences.

The last component for value creation that is able to deliver superior customer value is the development of a network through partnerships and co-operations. This happens through co-operations with small industry players that are able to develop the hardware component of the management system that *Arneg* than exploits for service delivery, by developing the logic on how to use them with customers. *Arneg* network is made of small industry players for strategic reasons: the technologies they use are fundamental for their services and since *Arneg* is their biggest clients, this creates a lock-in effect. These small companies do not try to develop the technology for themselves and in addition, they are dependent from *Arneg*, without whom they want survive. The company is also trying to separate components: each component is produced by the best-in-class company for that specific element. This requires

an ability that the company has developed over the years of recognizing the right partner for the right need.

Table 21. Summary of value capture component in Arneg to reach economic growth. Source: Own elaboration

SUPERIOR CUSTOMER VALUE				
CUSTOMERS	RESOURCES FOR BM	VALUE PROPOSITION	CUSTOMERS OPERATIONAL ACTIVITIES	NETWORKS FOR CREATING VALUE
<ul style="list-style-type: none"> • Relational and trustful relationship • Customers ask for data driven demonstration • Value added benefits for customers • International customer segmentation 	<ul style="list-style-type: none"> • Data are valuable resource to foster service innovation • Installed base • Human resources capable of selling services • Technological innovation • Customer relationship 	<ul style="list-style-type: none"> • Intangible service offerings is comprehensive for a small part of spare parts • Traditional physical product is customer-driven • Traditional product offering refrigerators centres and refrigerated counters • Traditional product offering t concerns with supermarkets accessories and cold stores. 	<ul style="list-style-type: none"> • The risk of operational failure for the company becomes a driver for service delivery • Company is able of solving a customer operational problem 	<ul style="list-style-type: none"> • Building co-operations and networks with small industry players with the aim of developing new technologies

Given the components of the *Business Model*, the result is that *Arneg* service is not only able to create value, but it is able to deliver a value that is enhanced in respect to the situation in a product-centric *Business Model*. The main reason is the attention toward customers.

Value delivery for reaching Resource Decoupling

Arneg's service offering is organized internally: it is a division inside the firm that is completely service oriented, but it isn't a company officially. This division is the one deciding all features of the service offerings (delivery and monetization), but also it is the part of the organization that decide how to program the software. While the technology (the hardware part) has been developed by an external company, it is this division that decides the logics base on which the software is programmed. This part is managed mainly by the energy manager himself.

Service offering is delivered by the internal division to almost 6500 stores. The decision to keep it internal is mainly due to reputational and brand reasons. The fear was that by creating a different firm, this firm would have lost the brand value to its customers and the service would have not been as successful as it has become. Indeed, the service is currently growing independently from products: a few years ago, the customer wanted to try the services driven by the product quality; now the customers first try the services and then try the products.

As it was previously discussed for *Energys*, this last part is dedicated to the explanation of the impact of *Arneg*'s service strategy delivery on the environment⁴⁵.

In this case study the relative resource reduction is not completely reached because the services that are delivered by *Arneg* are only able to reach 2 out of 3 resource reduction aims, which are: *reducing the need for resources during product use, reduce the need for producing the product*. Anyway, it is important to note that this means that the company's service strategy cannot classify as circular economy strategy⁴⁶, but it doesn't mean that services do not have any kind of environmental sustainability feature.

On the contrary, product maintenance is relevant in this context. It is delivered in the form of predictive, preventive and pro-active maintenance that is implemented thanks to the remote monitoring done through *IRIS management system*. This type of services activate the enabler of product longevity and is impacting the environment in the fact that the need for producing refrigerated cabinets is lowered and at the top of the value chain less resources are consumed and at the bottom of the value chain less waste is produced.

In addition, an important role in service delivery is done by the provision of operational support to clients. This is the most important service strategy for *Arneg*. It concerns particularly with the management of all electrical components, energy manages, optimization of energy consumption through a remote control system that allow the company to see where overconsumption or wrong use is cause waste in the use of electrical/energy in a supermarkets. This lead to the activation of the operational efficiency enabler that is able to reduce the need for resources during the use of refrigeration cabinets.

Though it can be highlighted that even though this service strategy cannot classify as complete circular economy strategies, the delivery of services through *PSSs* leads to a reduction of the impact of business activities to the environment. This leads to the conclusion that services and servitized *Business Model*, even if in a small part, is able once again to reduce environmental impact, proving that there is a correlation between service and environment.

The service strategy of *Arneg* is represented and detailed in *Table 22*.

⁴⁵ It refers to *Kjaer et al. (2018)* approach for verifying the correlation of *PSSs* strategies (i.e. Operational support, Product Maintenance, Take back or EoL, Product sharing, Optimized result) and circular economy. It is important to remember the aim is relative resource decoupling and the company can achieve this by 4 enabler that are: operational efficiency, product longevity, intensified product usage, product system substitution.

⁴⁶ It should be also noted that nothing is done to re-use or re-manufacture used products. This is mainly due to the type of product that is produced by *Arneg*.

Table 22. Summary of value delivery in Arneg to reach resource decoupling. Source: Own elaboration

RESOURCE DECOUPLING	
PRODUCT MAINTENANCE	OPERATIONAL SUPPORT
<ul style="list-style-type: none"> • Predictive and preventive maintenance through the use of remote monitoring • Proactive maintenance in order to prevent relevant damages to supermarkets 	<ul style="list-style-type: none"> • Management of all electrical components in a supermarket • Energy management services to more than 500 stores • Optimization of electrical and energy consumption by measurement through multimeters and sensors • Reduction of environmental footprint through energy services delivery • Remote control systems to reduce overconsumption and waste of resources when the supermarket is closed • 24h/24 monitoring service • Data analysis and correlations for support service using IRIS Energy

3.3.3 Challenges of Arneg PSSs Business Model

This part is dedicated to the presentation of challenges in the implementation of *Arneg PSSs Business Model*. It must be noted that due to the success of their service strategy, during the interview and the relative qualitative investigation only a few difficulties emerged.

These challenges are mainly related to economic factors. They are the following:

- services delivered by *Arneg* depend on highly technological products that are very expensive. In order to overcome this issue, the company must be able to charge a price that is capable of covering for these costs. This means that service managers must be excellent in making customers understand the value of their services so that the value perceived is able to compensate for the high price.
- the other problem is related to the customer and the type of investment that it requires. *Arneg's* services require expensive technology and time to develop and when the customer is too small and the investment does not seem to be profitable enough it is the product area manager that decides whether services should be offered. Though once again due to their high costs the company must be very careful in the customer that is chosen for service delivery.

3.3.4 Drivers for Product-service Systems adoption

The final section is dedicated to the description of drivers that should be enhanced with the aim of increasing the adoption of this type of *Business Models*, that as it emerged may represent an interesting alternative in order to respond to environmental challenges.

The main drivers that emerged have been grouped into clusters based on their nature. The clusters highlighted are presented hereby:

- *Strategic*: this type of drivers is mainly related to the fact that services are implemented in order to answer to a customer need. Customers are asking for services that support them in becoming more environmentally friendly. They want to externalize the management of part of their process in order to focus on their core businesses and they want to exploit services in order to boost innovation processes. As far as *Arneg* is concerned, it should be also noticed that for this firm lead users are fundamental, because they play a role in initial service development in the sense that when they ask *Arneg* to solve a problem, they develop a service that is able to solve it and then, when this is possible, they transpose it to other customers. Also, they develop both product and services in Italy where the customer is much more demanding, so that they are sure that the service is accepted for its high value also by other type of customers. This reasoning is well explained by *Arneg*'s culture of being customer-centric. Finally, they are important because they sustain companies in creating a long-lasting competitive advantage in respect to competitors and because services are fundamental in order to prove *OEMs* environmentally sustainable business activities for customers that are asking for it.
- *Economic*: first of all services are a tool able to conceive and integrate environmental sustainability and economic sustainability. Companies won't even consider a different *Business Model* if they are not economically sustainable⁴⁷, thus services being financially sustainable may be the tool that helps in conceiving the two dimensions. In addition to this, as it was largely proved before, services provide and foster economic growth in a company with is another reason why companies should implement them. And finally, services, especially energy efficiency services allow companies to reduce energy consumption, that is expensive in a supermarket to legal and necessary by design requirements (Refrigerators cannot be turn off, when they are closed).

⁴⁷ Environmental sustainability is driven by increases in cost efficiency and in money savings

- *Legal*: the last cluster concerns the legal requirements. In this interview, the main regulatory requirements emerged in relation to product characteristics (*HFO* and *HFC* in the following table). Despite this, it can be confirmed the importance of legislation, which is the main and most effective tool to induce companies to actually innovate their *Business Model* and in particular, in the perspective of giving the right economic incentive in order to lead companies toward an environmentally sustainable development.

Table 23. Summary of drivers for PSS adoption in Arneg. Source: Own elaboration

DRIVERS		
STRATEGIC	ECONOMIC	LEGAL
<ul style="list-style-type: none"> • Customers are asking for this kind of services • Lead users role in service implementation • Arneg's customer-centric culture • Long-lasting competitive advantage through service • Green image and marketing 	<ul style="list-style-type: none"> • Tool to make integrate environmental sustainability and economic sustainability • Foster economic growth of companies • Economic gains through energy efficiency services 	<ul style="list-style-type: none"> • Regulatory intervention to reduce <i>HFO</i> and <i>HFC</i> • regulatory interventions are able to influence firms actions

Conclusions

In the context of searching for new models able to respond to environmental issues, *Product-Service Systems* are presented as the solution. The business case research conducted to investigate this correlation, confirmed that providing services in addition to products (i.e. production machinery, refrigerated centres, etc.) is actually more environmentally friendly. In both cases, the service offering is able to deliver superior customer value, while ensuring economic growth to the companies and positive externalities to the environment.

Service provision is fostering economic growth both in *Arneg* and *Energys* because it grants higher margins than product sales and because the revenue models implemented provide more stable source of income through periodical fees. These models are confirmed as an instrument for approaching business activities while being at the same time financially and environmentally sustainable. As far as the latter is concerned, in the companies analysed, *Product-Service Systems* are able to achieve at least relative *Resource Decoupling* because they are able to reduce the need for resources through energy efficiency services and the need for producing new products by delivering maintenance services that extend products' life-cycle. On the other hand, these strategies cannot classify completely as *Circular Economy* strategies because they lack re-manufacturing services and End-of-Life management of consumed products. This is due, especially in *Arneg*, to the way in which its products are utilized during the use stage that doesn't allow re-manufacturing, and for current lack of interest in handling their used products.

Despite this, *PSSs* are environmentally friendly and are accepted in the market because they are able to answer to customer requests for superior value creation. Through a value proposition that combines products and services, *Energys* and *Arneg* are able to create valuable, long-lasting, relational relationships with customers that see their problems of energy wastes and consumptions solved by their *OES*. The exploitation of installed base, the availability of human resources capable of selling a service, I.o.T. tools, and the exploitation of partners knowledge are fundamental in this regard.

The most relevant finding is that, despite being confirmed as environmentally friendly, in neither of the two cases. *PSSs* are implemented with the goal of being environmentally sustainable. Environmental sustainability is an unintended effect (Matschewsky, 2019). As a prove, when asked about the practical environmental sustainability approach of their respective company both Energy managers immediately thought of a products application for

sustainability (i.e. a more efficient refrigerated counters or auxiliary system able to work on re-used or bio-plastic) and they didn't reflect immediately on the service part. Instead, *PSSs* are implemented because they foster economic growth, because of legal/legislative incentive (energy efficiency certificates in Energys or the obligation of maintaining a certain temperature in supermarket refrigerators for Arneg), because they foster the development of a competitive advantage and a differentiation strategy and because of the development and implementation of new technologies such as I.o.T. tools that can be exploited for gathering data and deliver the services.

This proves that the immediate implication of *PSSs*, at least in manufacturing companies, is not about "saving the environment". Yet, for the reasons already explained, they remain relevant in this regard. As a consequence it is fundamental to develop and work on these drivers, because *services* contribute to *environmental sustainability*. With the same reasoning, it is important to identify the challenges. The main ones are related to the organizational structure and culture. Service development requires a change of mentality for product-centric companies and it needs human resources that are capable of selling a service. In addition, there is a need for establishing the right revenue model and identifying the right level of costs.

Despite the evidence gathered, this study presents some limitations. First of all, due to the novelty of the topic it was difficult to identify more than two cases, while in order to enhance the reliability of the findings the number should have been higher. In addition, it could have been interesting to study cases of manufacturing companies that are implementing *pay-per-use or sharing business model*. Yet again, this is not happening often in the B2B industries. Thus, for the moment it was not deemed as fundamental. Finally, qualitative data are not as objective as quantitative ones and this study lacks a quantitative analysis of the phenomenon, which because of the rare implementation of the examined business model would have been difficult to develop and not significant.

On the other hand, this study relies on two exemplar cases of the manufacturing industry that are significant because, as confirmed by the industry experts, they present the typical features of the context that is analysed. In addition, the two companies were analysed in depth in their service strategies. This has been important in understanding whether their service strategies are relevant from an *environmental sustainability* perspective. Furthermore, triangulation was used in order to increase the reliability of qualitative data gathered. And finally, the present study is a valuable because it presents an alternative to traditional production models that are not environmentally sustainable anymore.

In particular, in this regard, this research has the merit of trying to propose a model for making *environmental sustainability* financially sustainable. As it emerged, this is fundamental because *ES* is mostly money driven in manufacturing companies since business activities that are environmentally sustainable are implemented only when they allow cost savings or higher profits through the creation of a differentiation advantage for companies. Services have proved to be able of satisfying all these requirements. Consequently, *Product-Service Systems* must be developed and incentivized also through legislative incentives, which play an important role. Because developing these models may not be the easier way to follow, but it is one of the most feasible in the perspective of overcoming the environmental problems that the current society is experiencing.

References

- Adrodegari, F. *et al.* (2017) 'The Management of Operations PSS business model conceptualization and application', *Production Planning & Control*. Taylor & Francis, 7287, pp. 1–13. doi: 10.1080/09537287.2017.1363924.
- Adrodegari, F. and Sacconi, N. (2017) 'Business models for the service transformation of industrial firms', *Service Industries Journal*. Taylor & Francis, 37(1), pp. 57–83. doi: 10.1080/02642069.2017.1289514.
- Avlonitis, V. *et al.* (2014) *Driving Competitiveness Through Servitization: A Guide For Practitioners*. 1st edn. Copenhagen: The CBS Competitiveness Platform.
- Baden-Fuller, C. and Haefliger, S. (2013) 'Business Models and Technological Innovation', *Long Range Planning*, 46(6), pp. 419–426. doi: 10.1016/j.lrp.2013.08.023.
- Baden-Fuller, C. and Mangematin, V. (2013) 'Business models: A challenging agenda', *Strategic Organization*, 11(4), pp. 418–427. doi: 10.1177/1476127013510112.
- Baden-Fuller, C. and Morgan, M. S. (2010) 'Business models as models', *Long Range Planning*. Elsevier Ltd, 43(2–3), pp. 156–171. doi: 10.1016/j.lrp.2010.02.005.
- Barquet, A. P. *et al.* (2016) 'Sustainability Factors for PSS Business Models', *Procedia CIRP*. Elsevier B.V., 47, pp. 436–441. doi: 10.1016/j.procir.2016.03.021.
- Bartolomeo, M. *et al.* (2003) 'Eco-efficient producer services - What are they, how do they benefit customers and the environment and how likely are they to develop and be extensively utilised?', *Journal of Cleaner Production*, 11(8 SPEC.), pp. 829–837. doi: 10.1016/S0959-6526(02)00157-9.
- Bilancio di Sostenibilità 2018 di Piovan S.p.A.* (2018).
- Bocken, N. M. P. *et al.* (2014) 'A literature and practice review to develop sustainable business model archetypes', *Journal of Cleaner Production*. Elsevier Ltd, 65, pp. 42–56. doi: 10.1016/j.jclepro.2013.11.039.
- Bocken, N. M. P. *et al.* (2016) 'Product design and business model strategies for a circular economy', *Journal of Industrial and Production Engineering*. Taylor & Francis, 33(5), pp. 308–320. doi: 10.1080/21681015.2016.1172124.

- Bonoma, T. V. (1985) 'Case Research in Marketing: Opportunities, Problems, and a Process', *Journal of Marketing Research*, 22(2), p. 199. doi: 10.2307/3151365.
- Boons, F. and Lüdeke-Freund, F. (2013) 'Business models for sustainable innovation: State-of-the-art and steps towards a research agenda', *Journal of Cleaner Production*. Elsevier Ltd, 45, pp. 9–19. doi: 10.1016/j.jclepro.2012.07.007.
- Bressanelli, G. (2018) 'Exploring How Usage-Focused Business Models Enable Circular Economy through Digital Technologies'. doi: 10.3390/su10030639.
- Bressanelli, G. *et al.* (2018) 'The role of digital technologies to overcome Circular Economy challenges in PSS Business Models: An exploratory case study', *Procedia CIRP*. Elsevier B.V., 73(July), pp. 216–221. doi: 10.1016/j.procir.2018.03.322.
- Čater, T. and Čater, B. (2010) 'Product and relationship quality influence on customer commitment and loyalty in B2B manufacturing relationships', *Industrial Marketing Management*, 39(8), pp. 1321–1333. doi: 10.1016/j.indmarman.2010.02.006.
- Chesbrough, H. (2002) 'The role of the business model in capturing value from innovation: evidence from Xerox Corporation's technology spin-off companies', *Industrial and Corporate Change*, 11(3), pp. 529–555. doi: 10.1093/icc/11.3.529.
- Chesbrough, H. (2010) 'Business model innovation: Opportunities and barriers', *Long Range Planning*. Elsevier Ltd, 43(2–3), pp. 354–363. doi: 10.1016/j.lrp.2009.07.010.
- Corbin, J. M. and Strauss, A. (1990) 'Grounded theory research: Procedures, canons, and evaluative criteria', *Qualitative Sociology*, 13(1), pp. 3–21. doi: 10.1007/BF00988593.
- Dimache, A. and Roche, T. (2013) 'A decision methodology to support servitisation of manufacturing', *International Journal of Operations and Production Management*, 33(11), pp. 1435–1457. doi: 10.1108/IJOPM-07-2010-0186.
- Doni, F., Corvino, A. and Bianchi Martini, S. (2019) 'Servitization and sustainability actions. Evidence from European manufacturing companies', *Journal of Environmental Management*. Elsevier, 234(January), pp. 367–378. doi: 10.1016/j.jenvman.2019.01.004.
- Doualle, B. *et al.* (2015) 'Investigating sustainability assessment methods of product-service systems', *Procedia CIRP*. Elsevier B.V., 30, pp. 161–166. doi: 10.1016/j.procir.2015.03.008.
- Douglas, D. (2003) 'Grounded theories of management: a methodological review',

Management Research News, 26(5), pp. 44–52. doi: 10.1108/01409170310783466.

Duncan, Robert B. "The ambidextrous organization: Designing dual structures for innovation." *The management of organization* 1.1 (1976): 167-188.

Ellen MacArthur Foundation (2012) *Towards the Circular Economy: Economic and business rationale for an accelerated transition*.

Fischer-Kowalski, M. *et al.* (2011) *Decoupling Natural Resource Use and Environmental Impacts from Economic Growth*, UNEP.

Gebauer, H., Krempf, R. and Fleisch, E. (2008) 'Service development in traditional product manufacturing companies', *European Journal of Innovation Management*, 11(2), pp. 219–240. doi: 10.1108/14601060810869875.

Geissdoerfer, M. *et al.* (2017) 'The Circular Economy – A new sustainability paradigm?', *Journal of Cleaner Production*. Elsevier Ltd, 143, pp. 757–768. doi: 10.1016/j.jclepro.2016.12.048.

Glaser, Barney G., Anselm L. Strauss, and Elizabeth Strutzel. "The discovery of grounded theory; strategies for qualitative research." *Nursing research* 17.4 (1968): 364

Goedkoop, M. J. . *et al.* (1999) *Product Service systems, Ecological and Economic Basics*.

Growth within: a circular economy vision for a competitive europe (2015) Ellen MacArthur Foundation. Available at:

https://www.ellenmacarthurfoundation.org/assets/downloads/publications/EllenMacArthurFoundation_Growth-Within_July15.pdf.

Haase, R. P., Pigosso, D. C. A. and McAloone, T. C. (2017) 'Product/Service-System Origins and Trajectories: A Systematic Literature Review of PSS Definitions and their Characteristics', *Procedia CIRP*. The Author(s), 64, pp. 157–162. doi: 10.1016/j.procir.2017.03.053.

Hu, H. A. *et al.* (2012) 'Development of sustainability evaluation model for implementing product service systems', *International Journal of Environmental Science and Technology*, 9(2), pp. 343–354. doi: 10.1007/s13762-012-0037-7.

Hubbard, G. (2006) 'Measuring organizational performance: Beyond the triple bottom line', *Business Strategy and the Environment*, 18(3), pp. 177–191. doi: 10.1002/bse.564.

Huber, J. (2000) 'Towards industrial ecology: Sustainable development as a concept of ecological modernization', *Journal of Environmental Policy and Planning*, 2(4), pp. 269–285. doi: 10.1080/714038561.

John Elkington, *Cannibals With Forks: The Triple Bottom Line of 21st Century Business*. Capstone, Oxford, 1997, 402 pp. ISBN 1-900961-27-X

Johnston, P. *et al.* (2007) 'Reclaiming the definition of Sustainability', 14(1), pp. 60–66. doi: <http://dx.doi.org/10.1065/espr2007.01.375>.

Johnston, W. J., Leach, M. P. and Liu, A. H. (1999) 'Theory Testing Using Case Studies in Business-to-Business Research', *Industrial Marketing Management*, 28(3), pp. 201–213.

Judge, W. Q. and Blocker, C. P. (2008) 'Organizational capacity for change and strategic ambidexterity: Flying the plane while rewiring it', *European Journal of Marketing*, 42(9–10), pp. 915–926. doi: 10.1108/03090560810891073.

Khan, M. A., Kalverkamp, M. and Wuest, T. (2019) 'Cascade Utilization During the End-of-Life of Product Service Systems: Synergies and Challenges', in Pehlken, A., Kalverkamp, M., and Wittstock, R. (eds) *Cascade Use in Technologies 2018*. Berlin: Springer Vieweg, Berlin, Heidelberg, pp. 1–7. doi: 10.1007/978-3-662-57886-5_1.

Kjaer, L. L. *et al.* (2018) 'Product / Service-Systems for a Circular Economy The Route to Decoupling Economic Growth from Resource Consumption?', *Journal of Industrial Ecology*, 23(1), pp. 22–35. doi: 10.1111/jiec.12747.

Kowalkowski, C., and Ulaga W. (2017) *Service Strategy in Action*. Service Strategy Press.

Leih, S., Linden, G. and Teece, D. J. (2015) 'Business Model Innovation and Organizational Design', *Oxford Scholarship Online*. doi: 10.1093/acprof.

Li, A. Q. and Found, P. (2017) 'Towards Sustainability: PSS, Digital Technology and Value Co-creation', *Procedia CIRP*. The Author(s), 64, pp. 79–84. doi: 10.1016/j.procir.2017.05.002.

Lightfoot, H., Baines, T. and Smart, P. (2013) 'The servitization of manufacturing: A systematic literature review of interdependent trends', *International Journal of Operations and Production Management*, 33(11), pp. 1408–1434. doi: 10.1108/IJOPM-07-2010-0196.

Lindahl, M., Sundin, E. and Sakao, T. (2014) 'Environmental and economic benefits of

- Integrated Product Service Offerings quantified with real business cases’, *Journal of Cleaner Production*. Elsevier Ltd, 64, pp. 288–296. doi: 10.1016/j.jclepro.2013.07.047.
- Lüdeke- Freund, F. (2010) ‘Towards a Conceptual Framework of Business Models for Sustainability’, *Knowledge Collaboration & Learning for Sustainable Innovation ERSCP- EMSU conference, Delft, The Netherlands*, 49(0), pp. 1–28. doi: 10.13140/RG.2.1.2565.0324.
- Manzini, E. and Vezzoli, C. (2003) ‘A strategic design approach to develop sustainable product service systems: Examples taken from the “environmentally friendly innovation” Italian prize’, *Journal of Cleaner Production*, 11(8 SPEC.), pp. 851–857. doi: 10.1016/S0959-6526(02)00153-1.
- Masson-Delmotte, V. *et al.* (2018) *Intergovernmental Panel on Climate Change-Global Warming of 1.5 Degrees Celcius, IPCC-Summary for Policymakers*. doi: 10.1017/CBO9781107415324.
- Mathieu, V. (2001) ‘Service strategies within the manufacturing sector: Benefits, costs and partnership’, *International Journal of Service Industry Management*, 12(5), pp. 451–475. doi: 10.1108/EUM0000000006093.
- Matschewsky, J. (2019) ‘Unintended Circularity?— Assessing a Product-Service System for its Potential Contribution to a Circular Economy’, *Sustainability (Switzerland)*.
- Matschewsky, J., Kambanou, M. L. and Sakao, T. (2018) ‘Designing and providing integrated product-service systems—challenges, opportunities and solutions resulting from prescriptive approaches in two industrial companies’, *International Journal of Production Research*, 56(6), pp. 2150–2168. doi: 10.1080/00207543.2017.1332792.
- Monier, V. *et al.* (2014) *Development od Guidance on Extended Producer Responsibility (EPR)*. Available at: [http://epr.eu-smr.eu/documents/BIO by Deloitte - Guidance on EPR - Final Report.pdf?attredirects=0&d=1%5Cnhttp://ec.europa.eu/environment/waste/pdf/target_review/Guidance on EPR - Final Report.pdf](http://epr.eu-smr.eu/documents/BIO%20by%20Deloitte%20-%20Guidance%20on%20EPR%20-%20Final%20Report.pdf?attredirects=0&d=1%5Cnhttp://ec.europa.eu/environment/waste/pdf/target_review/Guidance%20on%20EPR%20-%20Final%20Report.pdf).
- Mont, O. K. (2002) ‘Clarifying the concept of product-service system’, *Journal of Cleaner Production*, 10, pp. 237–245. doi: 10.1109/ACIIDS.2009.18.
- Moore, J. F. (1993) ‘Predators and Prey: A New Ecology of Competition’, *Harvard Business Review*, 71(3), pp. 75–86. Available at:

<http://blogs.law.harvard.edu/jim/files/2010/04/Predators-and-Prey.pdf>.

Nativa S.r.l. SB (2019) *Relazione di Impatto 2018*.

Neely, A. (2009) 'Exploring the financial consequences of the servitization of manufacturing', *Operations Management Research*, 1(2), pp. 103–118. doi: 10.1007/s12063-009-0015-5.

Neely, A., Benedettini, O. and Visnjic, I. (2014) 'The servitization of manufacturing: Further Evidence', *International Journal of Operations & Production Management*, 33(11/12), pp. 1408–1434. doi: 10.1108/ijopm-07-2010-0196.

Oliva, R., Gebauer, H. and Brann, J. M. (2012) 'Separate or Integrate? Assessing the Impact of Separation Between Product and Service Business on Service Performance in Product Manufacturing Firms', *Journal of Business-to-Business Marketing*, 19(4), pp. 309–334. doi: 10.1080/1051712X.2012.647797.

Opresnik, D. *et al.* (2013) 'Information – The Hidden Value of Servitization', pp. 49–56. doi: 10.1007/978-3-642-41263-9_7.

Osterwalder, A., and Pigneur, Y. (2010) *Business Model Generation: A Handbook for Visionaries, Game Changers and Challengers*. Hoboken, NJ: John Wiley and Sons.

Osterwalder, A., Pigneur, Y. and Tucci, C. L. (2005) 'Clarifying Business Models: Origins, Present, and Future of the Concept', *Communications of the Association for Information Systems*, 16(July), pp. 1–25. doi: 10.17705/1cais.01601.

Our Common Future (1987) *UN documents*. doi: 10.9774/gleaf.978-1-907643-44-6_12.

Parida, V. *et al.* (2014) 'Mastering the transition to product-service provision: Insights into business models, Learning activities, and capabilities', *Research Technology Management*, 57(3), pp. 44–52. doi: 10.5437/08956308X5703227.

Pieroni, M. P. P., Mcaloone, T. C. and Pigosso, D. C. A. (2019) 'Configuring New Business Models for Circular Economy through Product – Service Systems', *Sustainability (Switzerland)*.

Pieroni, M. P. P., McAloone, T. C. and Pigosso, D. C. A. (2019) 'Business model innovation for circular economy and sustainability: A review of approaches', *Journal of Cleaner Production*. Elsevier Ltd, 215, pp. 198–216. doi: 10.1016/j.jclepro.2019.01.036.

- Purvis, B., Mao, Y. and Robinson, D. (2019) 'Three pillars of sustainability: in search of conceptual origins', *Sustainability Science*. Springer Japan, 14(3), pp. 681–695. doi: 10.1007/s11625-018-0627-5.
- Raisch, S. *et al.* (2009) 'Organizational ambidexterity: Balancing exploitation and exploration for sustained performance', *Organization Science*, 20(4), pp. 685–695. doi: 10.1287/orsc.1090.0428.
- Rashid, A. *et al.* (2013) 'Resource conservative manufacturing: An essential change in business and technology paradigm for sustainable manufacturing', *Journal of Cleaner Production*. Elsevier Ltd, 57, pp. 166–177. doi: 10.1016/j.jclepro.2013.06.012.
- Reim, W. *et al.* (2017) 'Implementing Sustainable Product-Service Systems Utilizing Business Model Activities', *Procedia CIRP*. The Author(s), 64, pp. 61–66. doi: 10.1016/j.procir.2017.03.130.
- Reim, W., Parida, V. and Örtqvist, D. (2015) 'Product-Service Systems (PSS) business models and tactics - A systematic literature review', *Journal of Cleaner Production*, 97, pp. 61–75. doi: 10.1016/j.jclepro.2014.07.003.
- Roome, N. and Clarke, S. (2002) 'Sustainable Business', in, pp. 77–101. doi: 10.1007/978-94-017-2545-3_5.
- Spring, M. and Araujo, L. (2009) 'Service, services and products: Rethinking operations strategy', *International Journal of Operations and Production Management*, 29(5), pp. 444–467. doi: 10.1108/01443570910953586.
- Stake, Robert E. *The art of case study research*. Sage, 1995.
- Strauss, Anselm L. *Qualitative analysis for social scientists*. Cambridge university press, 1987.
- Teece, D. J. (2007) 'Explicating Dynamic Capabilities: The Nature and Microfoundations of (Sustainable) Enterprise Performance', *Strategic Management Journal*, 28(August), pp. 1319–1350. doi: 10.1002/smj.
- Teece, D. J. (2010) 'Business models, business strategy and innovation', *Long Range Planning*. Elsevier Ltd, 43(2–3), pp. 172–194. doi: 10.1016/j.lrp.2009.07.003.
- Teece, D. J. (2018) 'Business models and dynamic capabilities', *Long Range Planning*.

Elsevier Ltd, 51(1), pp. 40–49. doi: 10.1016/j.lrp.2017.06.007.

Tukker, A. (2004) ‘Eight types of product-service system: Eight ways to sustainability? Experiences from suspronet’, *Business Strategy and the Environment*, 13(4), pp. 246–260. doi: 10.1002/bse.414.

Tukker, A. (2015) ‘Product services for a resource-efficient and circular economy - A review’, *Journal of Cleaner Production*. Elsevier Ltd, 97, pp. 76–91. doi: 10.1016/j.jclepro.2013.11.049.

Tukker, A. and Tischner, U. (2006) ‘Product-services as a research field: past, present and future. Reflections from a decade of research’, *Journal of Cleaner Production*, 14(17), pp. 1552–1556. doi: 10.1016/j.jclepro.2006.01.022.

Tunn, V. S. C. *et al.* (2018) ‘Business models for sustainable consumption in the circular economy: An expert study’, *Journal of Cleaner Production*. Elsevier Ltd, 212, pp. 324–333. doi: 10.1016/j.jclepro.2018.11.290.

Voss, C., Tsirikrisis, N. and Frohlich, M. (2002) ‘Case research in operations management’, *International Journal of Operations & Production Management*, 22(2), pp. 195–219. doi: 10.1108/01443570210414329.

Voss, G. B. and Voss, Z. G. (2013) ‘Strategic ambidexterity in small and medium-sized enterprises: Implementing exploration and exploitation in product and market domains’, *Organization Science*, 24(5), pp. 1459–1477. doi: 10.1287/orsc.1120.0790.

Wirtz, B. W. *et al.* (2016) ‘Business Models: Origin, Development and Future Research Perspectives’, *Long Range Planning*, 49(1), pp. 36–54. doi: 10.1016/j.lrp.2015.04.001.

WWF (2018) *Living Planet Report - 2018: Aiming Higher*. Edited by M. Grooten and R. Almond. Gland, Switzerland. Available at:

<http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:LIVING+PLANET+REPORT+2004#0>.

Website References

Aida database (*Consulted on 30.01.2020*)

<http://andyneely.blogspot.com/2013/03/service-as-pre-sale-opportunity.html> (*Consulted on 30.12.2019*)

<http://www.asapsmf.org/finalita-e-mission/> (*Consulted on 13.01.2020*)

<http://www.oecd.org/environment/waste/extended-producer-responsibility.htm> (*Consulted on 30.12.2019*)

<https://ec.europa.eu/environment/ipp/> (*Consulted on 30.12.2019*)

<https://energys.piovan.com/it> (*Consulted on 26.01.2019*)

<https://www.arneg.it/it/arneg-world/le-origini-italiane> (*Consulted on 31.01.2019*)

<https://www.arneg.it/it/azienda/chi-siamo> (*Consulted on 05.01.2020*)

<https://www.arneg.it/it/azienda/codice-etico> (*Consulted on 30.01.2020*)

<https://www.arneg.it/it/service/un-evoluto-concetto-di-assistenza> (*Consulted on 30.01.2020*)

<https://www.confindustria.it/home/centro-studi/temi-di-ricerca/tendenze-delle-imprese-e-dei-sistemi-industriali/tutti/dettaglio/rapporto-industria+-italiana+-2019>. (*Consulted on 26.01.2020*)

<https://www.ellenmacarthurfoundation.org/> (*Consulted on 7.11.2019*)

<https://www.industry4business.it/esperti-e-analisti/creare-valore-con-leconomia-circolare-opportunita-di-business-e-spinte-verso-la-sostenibilita/> (*Consulted on 28.12.2019*)

<https://www.industry4business.it/esperti-e-analisti/creare-valore-con-leconomia-circolare-opportunita-di-business-e-spinte-verso-la-sostenibilita/> (*Consulted on 30.12.2019*)

<https://www.industry4business.it/servitization/arneg-non-solo-banchi-frigo-ecco-le-opportunita-digitali-della-servitization/> (*Consulted on 30.01.2020*)

<https://www.industry4business.it/servitization/arneg-non-solo-banchi-frigo-ecco-le-opportunita-digitali-della-servitization/> (*Consulted on 30.01.2020*)

<https://www.innovationpost.it/2019/11/14/dallafter-sales-al-customer-service-4-0-il-servizio-come-fattore-chiave-per-la-crescita-del-manifatturiero/> (*Consulted on 05.01.2020*)

<https://www.piovan.com/en> (*Consulted on 26.01.2019*)

<https://www.qualityresearchinternational.com/socialresearch> (*Consulted on 14.01.2020*)

<https://www.undp.org/content/undp/en/home/sustainable-development-goals.html> (*Consulted on 30.12.2019*)

<https://www.who.int/news-room/detail/02-05-2018-9-out-of-10-people-worldwide-breathe-polluted-air-but-more-countries-are-taking-action> (*Consulted on 04.02.2020*)

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Appendix 1- Industry Expert

1. Interview structure

Source 4. The interview was conducted on the 20.01.2020 and lasted 26' 26". The following questions were presented as a general structure but many topics were investigated in depth as issues emerged.

1. Secondo lei, qual è l'obiettivo principale delle aziende che scelgono di creare un'offerta integrata prodotto/servizio?
2. Nel *Business Model Canvas* (in seguito BMC), quali sono l'elemento chiave per un'azienda che adotta un modello di *Product-Service System* (in seguito PSS)?
3. Che cosa spinge le aziende ad adottare un *Business Model* che sia attento alla sostenibilità ambientale o che propone modelli di *Economia Circolare*? Al contrario, quali ostacoli incontrano nel loro percorso?
4. A suo parere, qual è il legame tra *PSS Business Model* ed economia circolare?
5. Che cosa spinge le aziende ad adottare un *Business Model* che sia attento alla sostenibilità ambientale o che propone modelli di *Economia Circolare*? Al contrario, quali ostacoli incontrano nel loro percorso?
6. Che ruolo svolgono in questo contesto il big data management e l'I.o.T? Nel BMC possono essere considerate (data management e IOT) tra le "key resources" per affrontare questi percorsi di sostenibilità ambientale?
7. Qual è il ruolo delle partnerships in questa situazione? Ha degli esempi in cui hanno giocato un ruolo chiave nell'implementazione di questo tipo di business model?
8. Secondo lei, quale potrebbe essere la struttura di costo per questo tipo di BM? E come potrebbero poi le aziende prezzare questo tipo di servizi (in pratica quale potrebbe essere il Revenue Model)?
9. Quali sono i settori (nel B2B) ad ora più orientati a questo tipo di business model e che contemporaneamente sono più attenti alla sostenibilità? Nel B2B, conosce aziende che offrono all'interno del pacchetto service dei servizi strettamente legati alla sostenibilità ambientale/economia circolare?

2. Interview's notes referrals.

This is an example of translation and coding process.

Interview source	Note #	Original Notes	Translated notes
4	197	Una delle motivazioni principali dal punto di vista strategico è la capacità di differenziazione.	One of the main motivations from a strategic point of view is the ability of differentiation.
4	198	E' molto facile copiare un prodotto fisico, ed è un pochino meno facile copiare un servizio, o meglio una combinazione prodotto servizio, perchè c'è anche una componente diciamo di competenza e di esperienza da un lato e una componente relazionale che sono...non proprio inimitabili ma più difficilmente imitabili.	It's very easy to copy a physical product, and it's a little less easy to copy a service, or rather a combination of a service product, because there's also a part of, let's say, competence and experience on the one hand and a relational component that are...not exactly unique but more difficult to imitate.
4	199	Quindi è una ricerca di vantaggio competitivo.	So it's a search for competitive advantage.
4	200	altri motivi sono legati alla capacità di generare fidelizzazione e soddisfazione soprattutto fidelizzazione diciamo come obiettivo che quindi porta a mantenere	other reasons are related to the ability to generate loyalty and satisfaction, especially loyalty we say, as an objective that therefore leads to maintaining

Interview source	Note #	Original Notes	Translated notes
		relazioni più durature con i clienti.	more long-lasting relationships with customers.
4	201	Contrattualizzare le relazioni con i clienti, quindi avere rapporti che sono strutturalmente di lungo periodo o di medio periodo diciamo, quindi tenere fuori i competitors, e quindi vincolati i clienti ad usare le nostre parti di ricambio piuttosto che i nostri servizi per un certo periodo	Signing contractual relationships with customers, allows to have relationships that are structurally long term or medium term, let's say, it allows to keep out competitors, and therefore to bound customers to use our spare parts rather than our services for a certain period of time
4	202	E infine ci sono vantaggi di natura più economica legati alla maggior profittabilità dei servizi per cui l'idea è che con un'offerta integrata si possono avere ricavi maggiori profitti maggiori e una maggiore stabilità dei ricavi, rispetto ai cicli economici	And finally, there are advantages of a more economic nature linked to the higher profitability of the services, so the idea is that with an integrated offer you can have higher profits and greater stability of revenues, compared to economic cycles.
4	203	Non ci mettere la sostenibilità ambientale come obiettivo ... sicuramente non lo metterei tra i principali.	I would certainly not put environmental sustainability as an objective ... I would certainly not put it among the main ones.
4	204	Essa può essere più un effetto collegato diciamo. La sostenibilità ambientale può nascere da obiettivi più di marketing in generale	It can be more of a related effect, let's say. Environmental sustainability can arise from more marketing objectives in general

3. Codifying the Interview

Note #	Sub - category 1	Category 1	Category 2	Category 3
202	Service allows companies to increase profitability through higher margins and stabler revenues	Companies experience economic growth through services	Economic sustainability and growth through services	Reaching economic growth through services
212	Thanks to servitization, environmental sustainability becomes financially attractive to companies	Servitization is considered a tool for practicing environmentally enhanced performances	Service provision is a mean to environmental sustainability	
221	It is very difficult to develop the right cost structure for services because of a lower competence in predicting investments costs and costs of delivering a service	Companies experience difficulties in establishing costs of delivering services	Economy as a challenge for PSS implementation	-
220	It is very difficult to develop the right revenue structure for capturing value from services	Capturing value from services is a challenge for inexperience companies		
207	Defining the right revenue model is difficult for the lack of experience in services			
216	Firm-specific performance is different each time, thus it is difficult to link payment to measures of use and performance	Product-oriented business models are driven by competitive reasons	Servitized product oriented business models are more representative of the manufacturing industry	-
215	Ownership importance in manufacturing industry is not driven by customers' value, but by competitive reasons			
217	The know-how used by B2B customers in their production, makes it difficult for them to use use-oriented services			
213	Companies are trying to develop use-oriented business models services, but this is not frequent.			
214				
200	Services contribute to the development of long-lasting relationship with customers, because they generate loyalty and customer satisfaction	Development of long-lasting relationships with customers	Strategic driver	-
199	Companies build service offerings to create a competitive advantage	Differentiation in the manufacturing industry		
198	Specific competencies and experiences of a firm lead to a difficult to imitate component of service offerings and to the creation of a long-lasting competitive advantage			
197	Differentiation of manufacturing industries is a strategic driver of PSS			
201	Services contribute to the development of lock-in effect with customers and to the creation of a long-lasting competitive			

Note #	Sub - category 1	Category 1	Category 2	Category 3
	advantage			
209	Environmental sustainability is fostered by expensive and scarce resources, in particular this is the case of reuse and recycling models	Environmental sustainability is driven by increase efficiency, thus reduced costs	Economic goals	Incentives to environmentally sustainable approaches
208 204	Environmental sustainability arises from marketing objectives	Customers' requests are the higher incentive for sustainability	Strategic goals	
203	Sustainability is not one of the key drivers for implementing PSS.	Sustainability is an unintended effect of PSS	Unintended environmental sustainable effect	Importance of services in approaching sustainability
205	Customers segmentation is helpful in order to implement the most suitable service offering	Increased attention toward customers' need	Customers	Need for an added benefit to customers
206	Value proposition need to be adapted to a product service offering in order to deliver benefits and enhanced advantages	Services deliver added benefits to customers		
211	Servitization delivers increased environmentally sustainable performances because it increased durability of products	Servitization delivers activities that are more environmentally sustainable	Service provision is environmentally friendly	Need for service delivery to implement resource decoupling
210	Servitization delivers increased environmentally sustainable performances because it reduces the number of products sold			
219	Depending on company's culture they can exploit partnerships as a mean to create value for customers (as an external source of competencies)	Networks are developed with the aim of creating value through services	Networks for value creation	Networks serves as a value creation component
218	Partnerships and network are useful to sell services where the installed base is dispersed around the globe	Networks are developed with the aim of delivering value through service delivery	Networks for value delivering	Networks serves as a value delivery component

Appendix 2 – Energys S.r.l.

1. Interview structure

Source 1. The first interview was conducted on the 15.05.2019 and lasted 47'32" The following questions were presented as a general structure but many topics were investigated in depth as issues emerged.

1. Com'è nata Energys? (motivo della separazione della BU)
2. Che cosa fa Energys? Efficientamento energetico? Chi lo fa?
3. Winenergy è gestito da voi assieme a Winfactory 4.0? Come funziona?
4. Che cosa fa Winenergy?
5. Perché vendete Winenergy come "prodotto"?
6. Chi sono i tuoi clienti? Per la maggior parte sono clienti di Piovan? Quanto "vende" la sostenibilità ambientale?
7. Ci sono "lead user" che usate per testare servizi sostenibili?
8. Bilancio di sostenibilità?
9. Per quanto riguarda Piovan, sai se fanno retrofitting o update dei macchinari esistenti? (per allungare il ciclo di vita?) Eco-design del prodotto? Nel design dei macchinari si riflette mai su cosa viene dopo - smaltimento?
10. Sai se si offrono servizi per aumentare la sostenibilità ambientale dei clienti?

Source 2. The second interview was conducted on the 21.11.2019 and lasted 36'00".

1. Puoi descrivere la situazione attuale in Energys? Cosa è cambiato da maggio?
2. Ci sono state delle modifiche in ciò che vorresti offrire ai clienti con il tuo progetto?
3. Quale strategia di PSS ritieni che si avvicini di più al tuo progetto?
4. A maggio hai parlato di un cliente chiedeva un servizio specifico. Come hai gestito la richiesta?
5. Partners: hai cercato un partner? Chi è (Core business)? Che competenze ti ha fornito?
6. Quali costi ritieni di dover affrontare? Ed hai pensato a che prezzo dare al tuo servizio?
7. Accoglienza da parte dell'azienda? Qual è l'intento di Piovan ora?
8. Come viene affrontata la sostenibilità ambientale in Piovan e in Energys? Benefici derivanti dal vostro servizio?
9. Che succede alle macchine alla fine del ciclo di vita? Se ne occupano i clienti?
10. Tra i benefici di sostenibilità ambientale quando si affrontano questo tipo di strategia si parla principalmente di "resource decoupling", ovvero ridurre il tasso di consumo di risorse aumentandone la produttività. Pensi che il tuo servizio potrebbe avere effetti in quest'ottica? Se sì, quali?

2. Interview's notes referrals

This is an example of translation and coding process.

Interview source	Note #	Original Notes	Translated notes
1	1	Piovan fattura sui €248 milioni e si classifica come una medio grande impresa	Piovan has a turnover of €248 million and is a medium-large company
1	2	Fornitura di apparecchiature ausiliarie, soluzioni ingegneristiche e servizi per l'industria della plastica ma anche di sistemi per l'industria alimentare e sistemi per la refrigerazione industriale.	Piovan is concerned with the supply of auxiliary equipment, engineering solutions and services for the plastics industry but also systems for the food industry and for industrial refrigeration.
1	3	Energys è una società di servizi energetici ufficialmente riconosciuta dal Gestore dei Servizi Energetici nata nel 2012 con l'obiettivo di fornire soluzioni per il risparmio energetico per ottenere certificati bianchi nelle macchine Piovan.	Energys is an energy services company officially recognized by the Gestore dei Servizi Energetici. It was founded in 2012 with the aim of providing energy saving solutions to obtain white certificates for Piovan machines.
1	4	Certificati bianchi, che sono una forma di incentivo che lo stato dà a chi decide di comprare una macchina più efficiente rispetto a quelle che ci sono nel mercato	White certificates are a type of incentive that the Government gives to those who decide to buy a machine more efficient than those that there are in the market
1	5	Ogni martedì c'è una borsa nella quale vengono venduti i certificati bianchi e le aziende vengono ripagate cash. I risparmi economici ottenuti grazie a questo processo, vengono poi divisi tra Energys ed il cliente finale secondo varie forme di partnership commerciale.	Every Tuesday there is a stock exchange where white certificates are sold and companies are paid back cash. The economic savings achieved through this process are then divided between Energys and the end customer according to various forms of business partnership.
1	6	Il modello di business è stato di creare una ESCo (Energy Service Company)	The business model was to create an ESCo (Energy Service Company)
1	7	Competenze verticali che mancavano a Piovan, che quindi si è unita ad una ESCo di Padova, ESCo Veneto, che era una piccolissima società di consulenza nel settore energetico di Padova.	Piovan lacked the needed specific technical competences, so they joined an ESCo of Padua, ESCo Veneto, which was a very small consulting firm in the energy sector of Padua.
1	8	In soli tre anni i risultati di Energys sono cresciuti in modo esponenziale. All'inizio gestivano solo 3 progetti, mentre ora ne gestiscono 30 e sono passati da un EBITDA di 5mila € a uno di 180mila €.	In only three years, Energys' economic results have grown exponentially. At the beginning they managed only 3 projects, while now they manage 30 and have grown from an EBITDA of 5 thousand € to one of 180 thousand €.
1	9	Rimane quindi tuttora libera di agire, e questa libertà le viene data perché grazie ad Energys la società dall'essere in perdita è andata in utile. Energys, infatti, contribuisce al bilancio positivo di Piovan, anche se in una minima parte.	She is therefore still free to operate, and this freedom is given to her because due to Energys results the company went experiencing losses to profits. Energys, in fact, contributes to Piovan's positive balance, even if in a small part.
1	10	Questa seconda persona è un ingegnere elettronico, ed era l'energy manager di una fonderia. Costui è un uomo di processo che riesce a dare valore ai dati che raccolgono	This second person is an electrical engineer, and he was the energy manager of a foundry. He is a man used to manage processes who manages to give value to the data they collect.

3. Codifying process

Business model components

Note #	Sub - category 1	Category 1	Category 2	Category 3
8	The growing ebitda of the servitized company prove that is a financially sustainable business	Current servitized BM is financially sustainable	Economic sustainability of the revenue model	Value capture to reach economic growth
21	The high impact of the services in the company's turnovers as prove that is a financially sustainable business			
68 69 72	Development of a realistic profit plan for future enhanced service offering through co-operations and partnerships with identification of possible costs and profits			
6	Creation a dedicated Energy Service Company with a specific revenue model providing energy service solutions to deliver an energy efficiency improvement service	Monetization of the current BM	Structure of the revenue model	
5	Division of economic savings between Energys and the end customer to capture value			
85 86	Structuring the monetization of the BM in two different sources: one-shot sale for the customization of the			

Note #	Sub - category 1	Category 1	Category 2	Category 3	
	architecture, repeated fee for granting access/updates or (as an upgrade) data analysis				
47	Main customers deal with plastic production, they have various dimensions and are mostly outside Italy	Customer segment	Customers	Value creation to reach higher customer benefit	
37	Customers value the provision of support services (information sales) regarding machines functioning	Delivering added value to customers			
54	Information that allows to increase the efficiency in energy consumption are valuable to customer since the related costs in plastic industry are very high				
53	Proving that customers' production processes are environmentally sustainable is a competitive advantage for customers				
52	Customers are not always willing to have external suppliers managing their own data	Importance of customer relationship management for service delivery			
89	The company has a high turnover useful for developing new sustainable business model	Availability of Financial resources	Resources for BM development		
1	High number of product sold and currently functioning are a resource for the new enhanced service delivery and also the current one	Installed base as a resource			
48	Acquisition of external competencies in order to become capable of delivering the current energy service	Search for skilled human resources			
7	Acquisition of new human resources capable of selling the new support service				
10	Acquisition of new human resources capable of selling the new support service				
78	Search for hiring skilled human resources able to work with non-energy data, make correlations and deliver valuable the enhanced support service				
79	Search for hiring skilled human resources able to work with non-energy data, make correlations and deliver valuable the enhanced support service				
43	There is a need for both management and technical skills/competences for delivering the current energy service	Technological resources are being used for enhanced services development			
11	Development of new software technologies as a resource for the implementation of current energy service				
14	Development of new software technologies as a resource for the implementation of the new enhanced support service				
41	Development of new software technologies as a resource for the implementation of the new enhanced support service				
56	Development of new software technologies as a resource for the implementation of the new enhanced support service				
77	Current energy services are fundamental for their impact to reducing environmental impact of business activities	Environmentally sustainable value proposition	Value proposition as a bundle of product and service		
94	Development of a product-oriented servitized business model based on data analysis for increasing production efficiency	Future development of the value proposition			
46	Possibility of new enhanced support services (process-oriented) development thanks to data analysis and technological innovation				
42	Possibility of new enhanced support services (process-oriented) development thanks to data analysis and technological innovation				
58	Creation a dedicated company providing energy efficiency services to customers	New intangible service offering			
3	Manufacturing company operating in the industry of machines for plastic, food, industrial refrigeration	Traditional physical product offering that concerns with machines for plastic, food, industrial refrigeration	Creation of a network for service value creation		
2	The ownership of the machine is transferred to the customer - product-oriented services	Traditional product offerings adapted to produce sustainable products			
13	The ownership of the machine is transferred to the customer - product-oriented services				
91	New product development to exploit opportunities coming from sustainability				
99	New product development to exploit opportunities coming from sustainability				
97	Development of co-operations and partnerships for the acquisition of highly technological product to achieve technological innovation for service delivery	Enabling technological development through partnerships			
70	Development of co-operations and partnerships for the acquisition of technological skills to achieve technological innovation for service delivery				
71	Development of co-operations and partnerships for the acquisition of technological skills to achieve technological innovation for service delivery				
100	Development of co-operations and partnerships for the acquisition of technological skills to achieve technological innovation for service delivery				
73	Development of co-operations and partnerships for the acquisition of technological skills to achieve technological innovation for service delivery				
74	Internally there is a lack of the needed skills for developing the new technologies to deliver a service offering	Delivering a product maintenance strategy - op. efficiency and pr. component longevity	Service provision		
76	Need for acquiring from the outside skills and "ready-to-use" technologies in order to enable the faster and easier development of a service offering				
75	The offer is a combination of physical product (machines) sold by one company and intangible services (energy efficiency services) sold by the another company of the group	PSS offering with a dedicated company		Creation of a structure for service delivery	Value delivery that enables Resource decoupling
12	Delivering a analysis service of the machine based on the data coming from it (the future servitized BM is product-oriented service)	Delivering an operational support strategy- op. efficiency			
87	Delivering a analysis service of the machine based on the data coming from it (the future servitized BM is product-oriented service)				
88	Delivering a analysis service of the machine based on the data coming from it (the future servitized BM is product-oriented service)				
92	Data analysis and correlations for providing qualitative support services				
36	Data analysis and correlations for providing qualitative support services				

Note #	Sub - category 1	Category 1	Category 2	Category 3
28	Goal of upgrading of the current service on energy efficiency management service			
17	Machine monitoring service for energy efficiency improvements through the use of sensors			
18				
27	Provision of an energy efficiency management service to save on energy consumption			
90	Result-oriented services are typical of energy service company, where the economic return is directly proportional to how much the machine is efficient	Delivering an optimized result strategy - value creation system substitution		

Challenges and drivers

Note #	Sub - category 1	Category 1	Drivers/Challenges
9	Profits growth of the servitized company as a reason of existence	Economic growth as a driver	Economic
26	Decreasing in demand for machines that meet legal incentive	Decreased impact of the legal driver	Legal
4	Creation of fiscal incentive by the Government as a driver for the creation of the company	Legal incentives as a business opportunity	
16	Development of technological upgrade of the software in order to meet the law requirements		
95	Business opportunities coming from the concern for the environment	Customer concern for the environment as a driver	Strategic
49	Customers difficulty in managing the energy and sustainability problem is an opportunity	Customer need for dealing with sustainability problem as a driver	
93	Customer demand for a more environmentally sustainable approach	Customer request as a driver	
33	Customer demand for handling externally the analysis of energy data		
35			
62	Customers are asking for technologies able to analyse data and give information about productio and energy efficiency		
30	Customers are asking for technologies able to analyse data and give information about productio and energy efficiency		
51	Possibility of a service development through a lead user		
50	Proving that production processes are environmentally sustainable is a competitive advantage for Piovan customers		
19	Current lack of predictive maintenance service and general well organized after-sales services	Lack of a product maitanance strategy - op. efficiency and pr. component longevity	
20			
39	Development of customer loyalty through service delivery	Retaining customers through service delivery	
63	Extraction of information from production data to increase production efficiency	Technological development as a driver for exploiting new business opportunities	Technological
64			
34	High number of data gathered by sensors which represent an unexploited resource		
66	Implementation of sensors and measurement instruments for gathering data and information useful for increasing production efficiency		
57	Technological development and data analysis is a business opportunity for Piovan		
24	Lack of a well-organized after-sales service due to highly profitable product business	Traditional business is highly profitable	Economic
83	Lack of effective economic incentives for service growth in Piovan		
25	Lack of incentive to innovation due to highly profitable traditional product business		
59	Product-centric organizational culture is making the development of such a service more difficult	Product centric mindset in the organization	Organizational Culture
44	Product-centric organizational culture is causing Piovan to sell a software as a product (simple one shot structure sold to customers)		
61	Product-centric organizational culture is making the development of such a service more difficult		
40	Product-centric current business model		
38	The small dimension of Energys inside Piovan group is making it harder to overcome product-centric mindset of Piovan		
60	Fear of cannibalization of the new services with the existing software of Piovan		
80	Lack of consistent growth due to human resources not able to sell services		
81			
84	Lack of confidence in selling something that they don't know well		
31	Loss of business opportunities due to path-dependency and	Path-dependency and	

Note #	Sub - category 1	Category 1	Drivers/Challenges
	organizational culture	organizational culture as obstacle to new BM development	
15	Development of a simple supervision software that is currently sold as a physical product	Traditional product offering also for a software	
29			
101	Difficult organization of a unique pathways in service creation	Lack of a linear/well organized structure development	Organizational Structure
23	Lack of a well-organized after-sales service due to internal organization reasons	Need for a renewal for an internal organizational structure	
82	Acquisition of external human resources capable of selling a service	Search for highly competent Human resources	
45	Organizational structure and possibility of acquisition by another company of the group is undermining the independence of Energys service	Delivery of a transversal service to Piovan customers	
65	Loss of business opportunity due to lack of fast technological development	Competitors are moving faster than Piovan	Strategic
67			
32	Loss of business opportunities due to misunderstanding of customer needs	Inability to understand customer changing need	
22	Products (machines) characteristics result in a lock-in effect for the customer	Lock-in effect resulting in organizational resistance to innovation	

Appendix 3 – Arneg S.p.A.

1. Interview structure

Source 3. The interview was conducted on the 19.12.2019 and lasted 2h 35'14". The following questions were presented as a general structure but many topics were investigated in depth as issues emerged.

1. Quali servizi innovativi e avanzati offrite che sono basati su IOT o comunque con connettività e analisi dati? Chi è il cliente tipico di tali servizi?
2. Che tipo di competenze cercate per offrire questi servizi (avanzati e digitalizzati)? Vi servite anche di personale esterno?
 - a. Indagare bene come si compone il gruppo interno / esterno che gestisce questi servizi
 - b. Adottare modelli di business di questo tipo richiede una collaborazione e costruzione di network. Qual è stata la vostra esperienza a riguardo?
3. Qual è la vostra visione sul tema della sostenibilità ambientale? Come la affrontate in azienda? Come è nata l'offerta di questi servizi, chi ne è stato promotore e da chi (gruppo interno / esterno) sono gestiti oggi?
4. Mi può descrivere la filosofia "Naturally Innovative"? E il programma Beenergy?
5. Quali costi sostenete per questi servizi innovativi? E come "monetizzate" l'offerta di questi servizi? Si tratta secondo lei di un vero e proprio nuovo business model per Arneg?
6. Ritenete ci sia stata una crescita economica grazie a queste offerte? Si possono avere dei dati?

2. Interview's notes referrals

This is an example of translation and coding process.

Interview source	Note #	Original Notes	Translated notes
3	102	Arneg nasce oltre 50 anni fa, azienda Italiana, di Padova, questa la sede principale, e a mano a mano che il business cresceva, crescevano le varie aziende, ci siamo spostati in giro per il mondo.	Arneg was born more than 50 years ago, an Italian company, from Padua, this is the head office, and as the business grew, the various companies grew, we moved around the world.
3	103	Nasce la prima sede qui, dove qui vengono fatte, dove siamo dentro noi, centrali e banchi frigoriferi. Quindi banchi frigoriferi dove compri lo yogurt e la centrale che li alimenta.	The headquarters originated in Italy, where they started producing refrigerators centers and refrigerated counters. Thus, refrigerated counters where you buy the yoghurt and the power station that feeds them.
3	104	Dopo di che, se ci pensate, all'interno del supermercato ci sono gli scaffali dove compri i corn-flakes, quindi il secco, e vengono fatti nella seconda sede che è stata costruita a Rovigo, che è la Intrac. All'interno di un supermercato devi conservare la merce, quindi ci sono le celle frigorifere, non sono visibili di solito perché sono nella parte dietro, e quella è la Incold. In più ci sono tutti quanti i banchetti a spina, che sono tutti quelli chiamati plug-in che sono banchi frigoriferi, tipo il frigo dell'algida dove attacchi la presa e il banco funziona, e quelli sono Oscartielle, di Bergamo.	After that, if you think about it, inside the supermarket there are the shelves where you buy the corn-flakes, then the dry, and they are made in the second location that was built in Rovigo, which is the Intrac. Inside a supermarket you have to store the goods, so there are the cold stores, they are not usually visible because they are in the back, and that's the Incold. In addition there are all the plug-in stalls, which are all those called plug-ins that are refrigerated counters, like the refrigerator of the algida where you plug in the socket and the counter works, and those are Oscartielle, from Bergamo.

Interview source	Note #	Original Notes	Translated notes
3	105	La telegestione è: all'interno di un supermercato viene montato un computer, che adesso è un computer industriale, un PLC praticamente, specifico per fare questo mestiere.	Remote management is: inside a supermarket a computer is built, which is now an industrial computer, a PLC practically, specific to do this job.
3	106	Il problema è che è collegato a tutti quanti i banchi frigo, e ci sono i parametri che devi settare, quello deve funzionare bene. Se si ferma quello avviene quello che si chiama "mancato freddo", quindi il banco non riesce ad andare in temperatura, c'è un'anomalia dell'HACCP, che ti obbliga, perché tutela noi consumatori a mantenere la merce ad una certa temperatura, se vai fuori di queste cose, e tu "supermercato" vendi questa merce, e per tua sfortuna qualcuno ti denuncia o stai male c'è denuncia penale, quindi non solamente sanzione economica.	The problem is that it is connected to all the freezer cabinets, and there are the parameters you have to set, that must work well. If you stop that happens what is called "lack of cold", so the counter can not go in temperature, there is an anomaly of HACCP, which forces you, because it protects us consumers to keep the goods at a certain temperature, if you go out of these things, and you sell these goods, and unfortunately for you, someone reports you or you're sick there is a criminal accuse so not only economic penalty.
3	107	All'interno del supermercato viene messo adesso un sistema di telegestione. Quindi fisicamente è come un computer di quelli che c'era una volta, uno scatolotto alla fine, che oramai viene venduto anche direttamente senza monitor, tastiera, mouse, niente perché è uno strumento che poi girerà in internet che anche se sei attaccato a lui ci arrivi tramite web e non ci arrivi direttamente e questo sistema viene collegato tramite una linea seriale che è un cavo rs485 che parte dal sistema e va a prendere tutti gli oggetti che io devo monitorare. Per ognuno di questi oggetti io come Arneg metto dei limiti, banalmente il banco della Arneg deve stare per legge tra i 2 e i 4 gradi; io metto che ne so 0.5 quello che è. Metto un Delta tempo e per dire sì potresti andare fuori per un minuto e tornarci dentro non mi cambia niente.	A remote management system is now being put into the supermarket. So physically it's like a computer of those that there once was, a little box at the end, which is also sold directly without monitor, keyboard, mouse, nothing. It is a tool that will run on the internet that even if you are attached to it you get there via the web and do not get there directly and this system is connected via a serial line that is a rs485 cable that starts from the system and goes to get all the objects that I have to monitor.
3	108	Il sistema ciclicamente continuativamente interroga tutti quanti i controllori perché per lui non è un banco frigo o una centrale è un controllore quello. Questo warning mi resta attivo e rimane warning per tutto il tempo che gli ho dato come tempo di attesa, supponiamo 10 minuti. Se entro 10 minuti Marco Foralosso ha preso lo yogurt, ha chiuso le porte, il banco riparte, la ventilazione riparte scende la temperatura torno dentro il secondo. Nell'attimo che scollino i 5 ° il secondo allarme, il secondo warning, si ricollega al primo e si annullano entrambi. Se invece passo i 10 minuti, quarto d'ora, quello che ho messo come tempo di attesa io, e lui continua a essere fuori temperatura quello diventa un allarme perché vuol dire che o uno si è addormentato con le porte aperte o c'è davvero un problema.	The system continuously interrogates all the controllers because for him it is not a refrigerated counter or a central unit that is a controller. This warning remains active for as long as I have set as waiting time, suppose 10 minutes. If within 10 minutes Marco Foralosso took the yoghurt, closed the doors, the counter starts again, the ventilation starts again, the temperature drops and I go back inside the second. The moment the second alarm goes off the 5th, the second warning, it reconnects to the first and cancels both. If instead I pass the 10 minutes, quarter of an hour, what I put as waiting time, and he continues to be out of temperature that becomes an alarm because it means that either one has fallen asleep with the doors open or there is really a problem.

3. Codifying process

Business Model Components

Note #	Sub - category 1	Category 1	Category 2	Category 3
129	Arneg turnover is given by services for 1/3 of the companies total turnover	Current servitized BM is financially sustainable	Economic sustainability of the revenue model	Value capture to reach economic growth
127	The company is experiencing an impressive revenue growth proving the servitization is financially sustainable.			
128	The service turnover is growing more rapidly than product sales turnover			
154	Through services the company is able to fidelize the client and increase its turnover.	Services increase the company financial sustainability		

Note #	Sub - category 1	Category 1	Category 2	Category 3
160	Services are a way to justify the higher prices of Arneg value proposition	Revenue model for combination of service/product offerings	Structure of the revenue model	
159	Services are the reason to charge a fee to customers, not the software itself			
156	To increase customer loyalty Arneg gives access to the software also to the customer	Relational and long-lasting customer relationship through service delivery		
157				
113	Arneg has provided access to the monitoring platform to enhance the customer relationship and gain trust from customers			
112	The service provider (Arneg) has developed a successful relationship through a clear contract and through taking some of the customers'operational risk into his own			
141	In order to capture customers attention, he delivers the service as a trial to have reliable data to give to customers about how much they will consume	Customers are convinced by data driven demonstration and deliver of added value to customers	Customers	
132	The service is able to build a competitive advantage for companies.	Delivering value added benefit for customers		
142	Services are useful to develop a long lasting and trustful relationship with the customers	Services are a mean for developing relationship with customers - delivering added value to customers		
152	Through service delivery the company is able to solve customer problems, making customer processes more efficient and saving costs			
153				
102	Arneg is an Italian multinational company working all around the world in a "local for local" way	The company works in a global environment		
116				
124	Services were developed internally because they enable Arneg to gather data about customer behaviour to further enhance both service and product development	Data are valuable resource for the company to foster innovation even more	Resources for BM development	Value creation to reach higher customer benefit
139	Large service and product delivery network internal to the firm	Human resources skills able to sell services		
140	Presence of key account services, which are completely focused on selling a service in stead of a physical product			
125	Product numerous installed base is a valuable resource for Arneg service delivery offer	Installed base as a resource		
171	The implementation services is decided by the responsible for product development, that have all the informations about how they work and what could be needed by customers			
115	Technological development allowed the company to normalize data and deliver a valuable service to customers (even across different brand controllers) and reduce the number of people needed to manage practical stuff.	Technological resources are being used for enhanced services development		
114				
105	Company's technological development (installation of a PLC) able to deliver a remote management service able to gather data and problems from the monitored objects			
107				
108	Technological sensors allow a precise monitoring of refrigerating conditions with the aim of signaling problems in the refrigerator benches.	Technology is a resource and tool for service development, while service delivery depends on the skilled human resources		
166	The external software house is the designing the technology, while internally they decide which data an correlations are important for customers			
167				
168	The technological hardware developed externally, because it is only a tool, while all the design of optimization is decided internally			
179	The firm is highly customer oriented, thus every customer request is satisfied and it is considered in order to become standard	The management of customer relationship is exploited as a resource for service development		

Note #	Sub - category 1	Category 1	Category 2	Category 3
	offering to customers			
143	Relationship with customers is based on the ability of solving their problems with the aim of becoming fundamental for them	Customer relationship is based on firm's ability to solve their problems	Taking over operational activities from customers	Value delivery that enables Resource decoupling
106	The potential legal/criminal consequences of the problem of "Lack of Cold" force the supermarkets to monitor freezer temperature constantly, which becomes an opportunity for service delivery and development.	The risk of operational failure for the company becomes a driver for service delivery.		
130	Spare parts after sales services represent only a small part of company's earnings	Intangible service offerings is comprehensive for a small part of spare parts	Value proposition as a bundle of product and service	
117	The physical products are modular, thus they can be customized and be adapted to customers' request which is Arneg's fundamental value.	Traditional physical product business has always been customer-driven		
118				
103	The firm produces both of refrigerators centers and refrigerated counters	Traditional physical product offering that concerns with refrigerators centers and refrigerated counters		
104	The firm produces also shelves for the supermarked (the so-called Intrac), the cold stores for storing goods and plug-in stalls.	Traditional physical product offering that concerns with supermarkets accessories and cold stores.		
181	Co-operations with small players increases firms partners loyalties toward the firm in technological development, because most of their turnover is due to Arneg	Building co-operations and networks with small industry players with the aim of developing new technologies	Creation of a network for service value creation	
182	Co-operations with the aim of building new services and new technologies with the help of big industry players is riskier because of the knowledge they extract and bring to competitors			
178	The network of companies developing the hardware necessary for the service is composed of about 10 companies			
176	The services internally check and validate proposals from external partners that develop the more technological components of the offer			
177	These networks are developed through the help of consultants and partners that are already working with them			
175	The firm is capable of identifying the right partners for each needed component. They have many partners/supplier for technology and each one is delivering a different part, the one they can better build.			
174				
123	Arneg value's proposition consists in a mixed offer between physical products (refrigerated counters, etc) and service intangible offering to 6500 stores	PSS offering developed internally through a dedicated service division	Creation of a structure for service delivery	
180	Reputational lack when creating a new company, this is why services are developed through an internal company division			
138	The services is growing as an offer that is independent from the product, first customers try the service and then they buy the product			
173	The company's service division is deciding how to program the software and the main part is managed by the energy manager, the responsible for the maintenance	The company is managing the service implementation and delivery internally		
183	Arneg can plan maintenance in advance and reduce physical interventions when not needed, with the use of remote controls.	Delivering a product maintainance strategy - op. efficiency and pr. component longevity	Service provision	
184				
136	The companies is proactive in giving advice about what needs to be substituted or not and what is needed as maintenance services.			
162	Arneg is dealing with all electric consumption in the supermarket, reducing all	Delivering an operational support strategy- op. efficiency		
163				

Note #	Sub - category 1	Category 1	Category 2	Category 3	
164	consumption in that sense				
161	Arneg is dealing with all electric consumption in the supermarket, reducing all consumption in that sense (comprehensive of lights, climate and all consumption in the building)				
126	Arneg is delivering energy management services to more than 500 stores.				
150	Dealing with electricity consumption is a way to reduce customers costs, reducing one of their problems				
185	Delivering energy efficiency service makes the company have a more sustainable impact.				
192					
155	The company is using sensors and multimeters to measure consumption and help firm in optimizing work				
193	The use of remote control systems enables to reduce waste of resources and excessive consumption when the shop is closed.				
110	The company has developed a 24/H monitoring service for the customer and has assumed the risk of operational failure				Delivering an operational support strategy- op. efficiency mixed with an optimized result strategy (risk taker is the provider)
111					
169	Data analysis and correlations are a resource for providing qualitative support services	Delivering an operational support strategy- op. efficiency			
158	Data are normalized thanks to a software (IRIS), analysis and correlations are a resource for providing qualitative support services				
165					

Challenges and Drivers

Note #	Sub - category 1	Category 1	Drivers/Challenges
121	Arneg innovation strategy, especially as far as services are concerned, is market pull. The customer is asking it.	Customers' request are fundamental for service delivery strategy of the company	Customers request as a driver
122	Big customer's requests for services are able to boost innovation processes		
119	Service development starts in Italy, where customers are much more demanding.		
120	Services are always developed in order to satisfy customers requests or solve their problems and then they are transposed to other customers.	Lead users are fundamental for service development in Arneg	
148	Products are changed much less rapidly than in the past, because of economic crisis which has lowered supermarkets turnover, leaving space for services	Economic crisis as a driver for services	Economic
189	Customers are interested in environmental sustainability as long as it is profitable for them	Economic sustainability must be satisfied, otherwise companies won't consider the environmental sustainability	
194	Environmental sustainability is driven by the consequent increases cost efficiency and money savings.		
134	Before the development of services, the turnover for these activities was almost 0, because they represented only a cost	Fostering economic growth through services	
145	Electricity costs are high because of legal requirements	Possibility of economic gains for customers from receiving an energy efficiency service	
146	Electricity costs are high because of legal requirements and necessary requirements (you can't turn off refrigerator when the supermarket is closed)		
144	Electricity represent is among the highest costs for supermarkets		
147			
149			
186	The regulatory interventions to reduce all HFO and HFC emissions is a driver to improve products sustainability impact	Environmental regulation as driver for environmental sustainability	Legal
187	Most important drivers are customers requests and regulatory interventions that are able to influence firms actions.	Legal and regulatory as well as customers request as business drivers	Legal/Strategic

Note #	Sub - category 1	Category 1	Drivers/Challenges
133	The company was forced to increment the service offer due to a customer request and its customer centric-culture.	Customer request as a driver for service offering growth	Strategic
135	The company is always incentivized to increment the service offer due to a customer request and its customer centric-culture.		
137	By delivering these services they are impacting on the sustainability impact and the green image of the supermarket		
151	Services are a tool for creating customers loyalty		
170	Customers are interested in environmental sustainability as long as it is profitable for them	Economic sustainability must be satisfied, otherwise companies won't consider the environmental sustainability	Economic
189	Environmental sustainability is driven by the consequent increases cost efficiency and money savings.		
194	Implementation of these sensors and monitoring tools is very expensive	High costs of technological resources provide a challenge for delivering services	
109	The area manager responsible for products and discussing with customers about products, are the ones deciding if it makes sense or not to deliver also services	The investment must be profitable enough to add services offerings to product	
172	Lack of take back and EoL management due to change in technologies and products	Lack of EoL and take back schemes	Product characteristics
196	The customers reuses products independently based on their needs.		
195			