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**PROVA FINALE**

**"Use-oriented & Result-oriented Product-Service Systems and sustainability"**


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# ABSTRACT

La tesi si propone di analizzare il legame tra Sostenibilità e i Product-Service Systems, partendo dal problema causato dal sovrasviluppo economico dell'uomo (inquinamento, sfruttamento delle risorse naturali a ritmi eccessivi) e dando una definizione dei PSS, analizzando le varie sottocategorie, individuandone le caratteristiche chiave, i punti di forza e di debolezza e fornendo alcuni esempi per facilitare la comprensione. Successivamente si tratterà lo sviluppo sostenibile, inteso come progettazione e distribuzione, esplicitando il ruolo dell'innovazione e del design strategico nel rendere i PSS una soluzione adeguata e favorevole sia per i consumatori che per i produttori. Infine, si mostrerà come le aziende leader in diversi settori investono in policy e pratiche volte a ridurre l'impatto ambientale in maniera nettamente superiore ad altre aziende, confrontando i dati tra aziende leader del settore, aziende normali e aziende italiane. La tesi si concluderà con la proposta di "best practices" che le aziende dovrebbero adottare per ridurre l'impatto ambientale favorire lo sviluppo socio-etico, inseguendo allo stesso tempo il lucro economico.

# INTRODUCTION

## ENVIRONMENTAL CHALLENGES

The aim of this thesis is to describe the relation between Product-Service Systems (PSS) and Sustainability, proving why so many researchers look at PSSs as a possible solution to pollution generated by the human development model, a model that can drastically reduce the human footprint on the planet and its ecosystems.

As a matter of fact, the impact of humankind on Earth has been so important and vast that many scientists agree on a new geological period, the *Anthropocene* (Crutzen and Stoemer 2000). Such period as been conventionally placed at the beginning of the industrial revolution and symbolizes that the human lifestyle is profoundly changing the environment surrounding us.

The main problem of human development is the negative conditions our way of living is imposing to the planet. It has been proved by several scientific researches that the planet is going through some radical changes driven by human pollution, such as a huge increase in carbon dioxide, deprivation of natural resources (mineral, oil and gas) and deforestation. The effects of our development policy are getting clearer every day since it has been proved many times that human activity raised the level of global temperature, carrying devastating climate changes. This path is not sustainable even in the resource-availability point of view: access to drinking water, energy, arable land and smog-free living areas is becoming thinner by the day and biodiversity is dying because of it.

To understand the extent of the harvest of natural resources perpetuated each year by mankind, according to WWF, we should consider that the planet takes approximately 1.5 years to regenerate the resources used in 2007 (WWF 2010). The amount of resources needed to sustain human activity however has increased since 2007, getting higher each year. Without any changes, it is estimated that in 2030 humanity will consume the Earth's capability at twice the rate of regeneration. If we take for example the lifestyle of a resident in the United States of America and extend it to all people living now, we would need more than 4.5 Earths to keep up with consumption.

To address this issue, governments worldwide designed practices to control and reduce pollution starting in the late 1960s. According to Simons, we can define four generations of approaches (Simons et al. 2001). The **first generation** consisted in remediating to pollution waste after it has been produced. "*Industry reacted defensively, or even with hostility… Environmental management was not a strategic issue, and responsibility for environmental issues was often delegated to an environmental staff department*" (Simons 2001, pg 52). The **second generation** started in the 1980s and shifted from a end-of-pipe solution to a prevention-based approach (which earned the generation the definition of "*cleaner production strategies" (*Ceschin 2012)). However, it became clear that pollution didn't end with production, but it continues nonetheless during the life cycle of products. That is the reason of an ulterior shift on a **third generation** approach focused on decreasing the impact generated by the products' life cycle (constituted by usage, distribution and end-of-life/waste). The last and most important approach however is the **fourth approach**. This approach is based on switching the focus from product improvements only to a more radical change, which considers pollution control, life-cycle of products and structural design to improve efficiency and lower the impact on the environment (Ceschin 2012).

The fourth approach is to be considered the most important for the objective of this thesis since it enhance the value of Product-Service Systems as possible solution to a long-term sustainability. As a matter of fact, PSS incorporate many of the structural changes companies and public services should embrace in order to achieve sustainability due to aspects and factors which will be elaborated in detail in the following part the thesis.

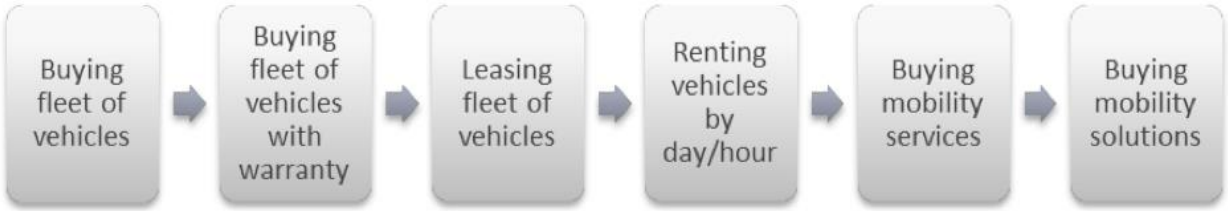
# 1. PRODUCT SERVICE SYSTEMS

## 1.1 DEFINITION

There is not one and only good definition for PSS, since it has been modified and changed as the research continued. According to Tukker, "*A Product-Service system (PSS) can be defined as consisting of 'tangible products and intangible services designed and combined so that they jointly are capable of fulfilling specific customer needs'* (Tukker, 2004, page 246) (For more definitions see *figure 2*).

A definition from a wider and more general perspective comes from UNEP, "*Product service systems (PSS) are service-oriented* ***business models*** *that replace selling products with selling services – or with selling a mix of products and services. These systems focus on fulfilling customers' needs rather than on product purchases*." (UNEP 2015)

As it is stated in the annual report of UNEP (United Nations Environment Programme), PSSs shifts the focus from the need of an object to the actual need of the customer. (UNEP 2015)




"As it is shown in the Figure 1, the focus moves from product ownership to product utility and therefore fulfillment of a need through a service (Source: UNEP, 2015)."

Mont helped us identify he key elements of a PSS (Mont 2002a, Ceschin 2012):

- **Products** as tangible goods in the system;
- **Services:** services are to be considered as action to grand products availability (sales services, renting, sharing, etc…) and management of products in use and end-of-life phases (maintenance, upgrading, retirement, etc...)
- **Actors:** it includes all the socio-economic actors needed to produce and deliver the PSS,
- **Infrastructures:** infrastructures play an active role in defining the PSS structure. It represents a bilateral relation since the company should adapt its configuration to the surrounding environment and at the same time a PSS can affect the development and change of already existing infrastructures.

Quoting Mont, "*... PSSs consist of a combination of eco-designed products, reinforced by designed services at different stages of a product's life cycle, and comprising different concepts of the product use... closely involving final consumers and actors in the chain and beyond"* (Mont, 2002a)

PSS' strategic strength comes from the fact that it avoids the conflict of interests which the traditional relationship between purchasers and sellers implies. Normally, a customer wants to reduce as much as possible the cost of acquisition of a good while the aim of a company is to sell it at the highest possible price and at the highest possible quantity. This conflict is worsened by the fact that normally products involve maintenance and management costs for the consumer (Ceschin 2012).

A PSS finds his strength in this reason of the conflict since, as it's stated in the UNEP technical report, "*Product-service systems realign the relationship between suppliers and customers by taking a product's life-cycle costs into account*" (UNEP 2015). This is possible since the supplier retains ownership of the product and sustains all life-cycle costs a product implies, therefore the need to decrease cost over time is shared by both the seller and the purchaser.

| Author/s | Year | Definition |
|---|---|---|
| Goedkoop, van Halen, te Riele and Rommens | 1999 | A PSS (or combination of products and services) is a set of marketable products and services jointly capable of fulfilling a need for a client. [...] The PSS may lead to a benefit for the environment in connection with the creation of a (new) business. |
| Mont | 2001 | PSS is a system of products, services, networks of actors and supporting infrastructure that continuously seeks to be competitive, satisfy customer needs and have a lower impact than traditional business models. |
| Centre for Sustainable Design | 2001 | A PSS is a pre-designed system of products, supporting infrastructure and necessary networks that fulfil a users needs on the market, have a smaller environmental impact than separate product and services with the same function fulfilment and are self learning. |
| UNEP (Manzini and Vezzoli) | 2002 | A PSS is the result of an innovative strategy that shifts the centre of the business design and sale of products only (physical) to systems offering products and services that are jointly capable of satisfying a given application |
| Brandsotter et al. | 2003 | PSS is a product of material and intangible services designed and combined so that both jointly are able to satisfy a specific need of a user. In addition a PSS may reach sustainability targets. |
| Wong | 2004 | A PSS may be defined as a solution offered for sale that involves both a product and a service element, to deliver the required functionality. |
| Van Halen, Vezzoli and Wimmer | 2005 | A PSS is the result of an innovation strategy focused on the design and sale of a system of products and services that are jointly capable of fulfilling a specific customer demand |
| Baines et al. | 2007 | PSS is an integrated offering of a product and a service that provides a value. Using a PSS offers the opportunity to decouple economic success from material consumption and thus reduce the environmental impact of economic activity. |
| UNEP (Tischner, Ryan and Vezzoli) | 2009 | A PSS is a system of products and services (and infrastructure), to jointly cope with the needs and demands of customers in a more efficient way with better value for both businesses and customers, compared to only offering products [...]. PSS can decouple the creation of value from the consumption of materials and energy and thus significantly reduce the environmental impact in the life cycle of traditional product systems. |

*"FIGURE 2: list of definitions of PSS according to different researchers (Source: Ceschin, 2014)"*

The PSS' framework exists within a general concept that switches the perspective from an industrial economy (based on the traditional production-selling archetype strictly depending on resources and sales volume) to a "functional economy", in which the target is the function of the product sold, whether it is a material good or service, aiming to fulfill the need exhibited by consumers (Mont 2002). Quoting Stahel, "*Functional economy is an economy that optimises the use (or function) of goods and services and thus the management of existing wealth (goods, knowledge, and nature). The economic objective of the functional economy is to create the highest possible use value for the longest possible time while consuming as few material resources and energy as possible. The functional economy, which is focused on production as its principal means to create wealth and material flow*" (Stahel 1997).
In a functional economy, manufacturers and retailers are paid per unit of utility delivered to consumers, and not per unit of total volume sold. We can say the main objective is to provide a performance measured and engineered to reach customer satisfaction (Ceschin 2014). Therefore, there is an economic incentive for producers to reduce material and other resources to deliver that satisfaction in order to reduce overall cost and take advantage of material/energy optimization and product life-spawn improvement.

Even though Product-Service Systems have been presented as a general classification of a product, they can be further disassembled into smaller fractions. As a matter of fact, based on the nature of the final product, PSS can be divided into three main categories (Baines et al, 2007):

- Product-oriented PSS
- Use-oriented PSS
- Result-oriented PSS

In the next session, each of the three types of PSS will be discussed and analyzed individually.

### 1.1.1 PRODUCT ORIENTED PSS

A product-oriented PSS provides a post-purchase service of a product, increasing the value by offering services such as maintenance, repair, re-use, recycling, take-back, training and consulting). In this type of PSS, the product is sold in a traditional way, meaning the customer buys the ownership but the cost related to life-cycle of the product are sustained by the seller, which will consequently be interested into decreasing them as much as possible. Therefore, the

company will develop the product taking into account the impact in order to increase the durability, introduce modularity to improve and facilitate repair, upgrade and re-use of the good and thus lowering the overall costs sustained in the life-cycle of the product.

### 1.1.2 USE-ORIENTED PSS

A use-oriented PSS consists on "*access to products, tools, opportunities or capabilities that enable customers to meet the particular satisfaction they want (in other words efficiently satisfying a particular need and/or desire)*" (Vezzoli, et al., 2018). Instead of paying for owning the product, a customer pays for the utility and functions that come with the good but does not own it. Therefore, the type of contract developed is a pay-per-use kind of one. "*The customer could have the right to hold the product/s for a given period or time or only for one use"* (Vezzoli, et al., 2018) A company that exploits this type of offer is driven to increase efficiency and durability in its products since it lowers the costs and improves performance and quality of use of them for the customer. "Xerox International" represents a successful example of this category: it provides the customer a professional printer and then charges him with a fixed price per copy, therefore the customer doesn't pay the printer but pays only for the use he makes of it.

### 1.1.3 RESULT-ORIENTED PSS

A company (alliance of companies) that provides a customized mix of services (as a substitute for the purchase and use of products), in order to provide an integrated solution to meet a particular customer's satisfaction (in other words a specific final result). The mix of services does not require the client to assume (full) responsibility for the acquisition of the product involved. Thus, the producer maintains the ownership of the products and is paid by the client only for providing the agreed results (Vezzoli, et al., 2018). Typical activities of this type of PSS are activity management/outsourcing and functional result (for example illumination). A good case of this type of PSS is the "solar heat service", which provides the final result (hot water) to the customer.

AMG [1]sells heat and then bases its price on the thermal kilowatts consumed by the client (in 2001 one liter of hot water cost 0.2 euro cents). The company does not involve the client with installation, transportation and measurement but sells him directly the final result (Vezzoli, et al., 2014).

Considering the fact that a customer doesn't have to pay for the technology to obtain a certain result, a PSS innovation of this kind might actually give access to low-middle tier income people to services and functional results that the traditional sales model could not.

## 1.2 SUSTAINABILITY AND PSS

After describing the three sub-categories of PSS it is now time to introduce a macro-category that incorporates and evolves the standard definition of PSS, the "**Sustainable Product-Service System (S-PSS)**". A **S-PSS** can be defined as an *".. offer model providing an integrated mix of products and services that are together able to fulfill a particular customer demand (to deliver a "unit of satisfaction"), based on innovative interactions between the stakeholders of the value production system (satisfaction system), where the ownership of the product/s and/or its life cycle responsibilities remain by the provider/s, so that the economic interest of the providers continuously seek new environmentally and/or socioethically beneficial solutions" (Vezzoli et al 2018)*

### 1.2.1 SUSTAINABILITY TRIPLE BOTTOM LINE

In order to understand the link between S-PSS and sustainability we first must identify and explain the drivers of socio-environmental responsibility. Business sustainability is, as acknowledged by many different authors, divided into 3 main areas:

- Environmental sustainability: it involves reducing the impact by utilizing renewable sources of energy, exploiting the soil's resources at a pace such to allow the eco-system

[1] AMG is a company that offers a "solar heat service", in which customers pay based on units of hot water consumed. AMG does not involve the client with the technology used to deliver the final result, the client pays for a comprehensive service from installation, to transportation of fuel and then the hot-warming system. For more see http://www.amgenergia.it/ (Source Ceschin, 2012)

to generate them back without getting deficit and reducing as much as possible pollution;

- Social sustainability: social sustainability is about guaranteeing equity, the so called "social-welfare" in a company so that the employees can work in safe conditions and pursuit self-realization;

- Economical sustainability: this category of sustainability is about respecting the economic rule of generating an income higher than the cost sustained to produce it in the long term, in order to satisfy different needs of the market.

When talking about sustainability this three aspects must be integrated and developed each taking into consideration the other two. As a matter of fact, all of them must be respected at the same time to achieve sustainability in the long run, since if even one is not integrated the firm is not available to satisfy its and consumers' needs without compromising the possibility of future generations to satisfy theirs (Pedrini and Zaccone, 2019). Furthermore, social and environmental sustainability become key factors for those companies whose competitive advantage relies on reputation and therefore need to consider a multitude of stakeholders.
We will discuss about the methods by which a company shall integrate sustainability later, after explaining some of the sustainability factors

### 1.2.2 SUSTAINABILITY FACTORS

The Triple Bottom Line is a good indicator of performance for sustainability mostly for stakeholders and does not represent a good economic driver for greener innovation. Different companies have been performing better in the financial market thanks to major investments regarding the TPL but that is due to an improvement in the reputation and image of the brand, since customers are now more aware of the environment and take into consideration the firm's value proposition when evaluating products. However, through this perspective sustainability appears to be a cost for the company since its benefits are subjective and not measurable and therefore cannot represent a safe added value to products. To overcome this idea, many researchers have analyzed drivers for sustainability that go deeper into firms' processes and product development, finding factors which enhance the value of products and might prove to be a source of profits. Barquet et al. have identified 5 main factors and different subfactors in

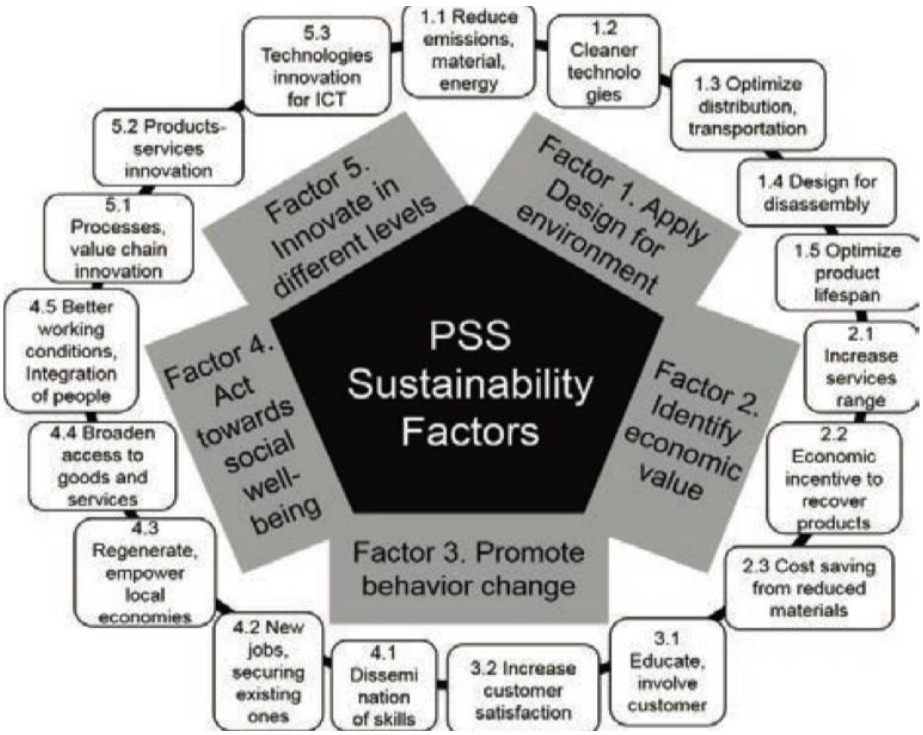
their research about drivers for sustainability (See figure 3, indicating Sustainability factors from Barquet, et al., 2016).

1. **Factor 1: Design for environment**: according to Vezzoli, et al. (2018), the main solution to increase the overall performance of products during their life-cycle are to minimize the volume of material required to produce a single unit and the waste generated by mass production, select specific materials that are renewable or can be recycled, minimize energy consumption, usage of cleaner technologies for manufacturing (normally greener technologies are also more advanced and thus more efficient), optimize the stage of distribution and take-back, developing modular products that can be dissembled, upgraded and repaired easier and with less waste. Standardization and modularity have a double benefit since their direct consequence is more efficiency in production, adding economic benefits value to the environmental one.
2. **Factor 2: Identify economic value:** in a PSS, the economic value resides in different aspects. Considering the first factor of sustainability, more efficient production and product design might be seen as cost saving practices, since less production efforts, re-use of products and recycle of material target the overall cost of a product which is amortized through it life spawn. Furthermore, a PSS should increase in terms of range of services since each company should explore and thus exploit additional services that might increase the perceived value of a product.

3. **Factor 3: promote behavior change:** this factor is one of the most tricky to deal with since many products are carriers of a symbolic value and, in particular luxury goods, a status. This is all due to a general view of the purchasing needs that customers share, "*many customers also lack a general understanding about life cycle costs"* (Ceschin 2012 page 34). According to Behrendt, "*solutions based on sharing and access contradict the dominant and well-established norm of ownership*" (Ceschin, 2012, page 34, Behrendt 2003). To change the common perspective, the company should be able to train and educate customers to develop a sustainable consciousness to act and behave in a more responsible way (Barquet, et al., 2016). A major involvement in the development of mixed services aimed at each customer specifically represents a useful instrument to promote behavioral change. Furthermore, a company should enable a policy of transparency and show the social-environmental benefits of switching from a traditional

concept of ownership to an innovative idea of shared ownership or simply to understand the economic advantages of not buying a product but buying a result.

4. **Factor 4 Act towards social well-being:** thanks to the benefits partially stated talking about result-oriented PSS, a company which sells this kind of product can give to lower-income families access to services and goods they wouldn't be able to afford in a traditional way. Looking at this aspect through a wider view, many developing countries can benefit from the drastic reduction of initial investments and life-cycle costs thanks to the purchase of the "final result", ending in a better condition and quality of life (PSS lowers the cost and increases the social welfare). To furthermore boost the perceived benefit of a PSS, since they are more labour and relationship oriented, the company should increase local employment as it could also lead to dissemination of skills (Barquet, et al., 2016, Vezzoli 2015).
5. **Factor 5: innovate in different levels: "***Despite the fact that product and services are central in the PSS definition, innovations in technology and value chain are the most mentioned in research about sustainable PSS business models*" (Barquet, et al., 2016). Normally all the participants in the value chain of a traditional business model tend to optimize only their segment and with no regards to the overall performance of the chain. Therefore, a good starting point to create a PSS business model would be to align economic value for each stakeholder and an overall resource optimization, then integrate all the players of the chain. This integration can be achieved by designing the value chain considering all the interests of the stakeholders. The "*convergence between environmental and economic interests is defined eco-efficiency*" (Ceschin 2013). A properly integrated value chain has fewer overall costs and the total gains (both eco-efficiency and economic efficiency) can be shared among the participants. Another important level of innovation is the technology to develop, produce and distribute products and services. More efficient technologies allow companies to develop more environmental-friendly and user-friendly products/services.




*"FIGURE 3: Factors and sub-factors for PSS sustainability (Source: Barquet et al 2016)"*

After explaining the 5 sustainability factors, it is clear that the advantages of sustainability affect all 3 categories of PSS in the same way. By developing these 5 factors, companies that offer PSSs might be able to increase the profit through optimization, promote environmental conditions by educating customers and reducing the impact of products and improve the quality of life by offering better opportunities and access to more advanced products to customers.

# 2. SUSTAINABILITY INTEGRATION, INNOVATION, DRIVERS AND BARRIERS

The relationship between sustainable development and business performance has been researched carefully over the last decades. In particular, the main aspects researched about sustainability are the ones regarding when it pays-to-be-green.

It is broadly accepted nowadays that companies who invest in green solutions and take care of the environmental impact their products have, tend to perform better and are rated higher in markets of stock exchange. Investing in the Triple Bottom Line perhaps improves the corporate image of the firm. The pursuit of ecological improvements is usually stated in the business

model of these companies, since it enhances the awareness of the customers about the efforts sustained by the company. As a matter of fact, the business model is where the integration starts. According to Doganova and Eyquem-Renault (2009), "*the business model is divided into 3 areas: the value proposition that clarifies the offerings of the firm, the partners and channels through which value is produced and delivered, and the revenue model that focuses on costs and revenue flows*" (Hall, Wagner 2011). As we understand from this narrow approach to "business model", integration of sustainable practices plays a vital role in the first and in the second area since it influences the value proposition of a firm and it also sets a certain type of standard for the company's partners.

As a proof of the importance held by sustainability towards the stakeholder, many systems have been developed to classify, certificate and help companies measure their performances in terms of environmental impact, standards such as the ISO 14001, UN Global Compact and the Global Reporting Initiative (GRI). These non-profit companies aim to help firms on the path of sustainability by supplying rigid standards and help throughout the accounting and administration of investments targeting sustainability (Hall, Wagner 2011).

Helped by non-profit organizations (like the companies just described) and driven by a general desire of the population to lower our biological footprint on the planet, international politics have pushed private and public organizations towards the concept of "sustainable development". According to Vezzoli et al. this term refers to conditions where both social and productive development takes place (Vezzoli, et al., 2014):

- within the limits of environmental resilience,
- without compromising the ability of future generations to meet their own needs
- on the principle of equal redistribution of natural resources.

Sustainable development occurs in three dimensions, referred to as Triple Bottom Line as explained in the previous part of the text: **environmental** (Planet), **socio-ethical** (People) and **economic** (Profit).

The **Environmental** dimension is about the effects production has on the eco-system in which it takes place. These effects happen in two directions (Vezzoli, et al., 2014):

1. as *input*: extracting resources from the surrounding environment. As negative consequences of intensive resource extraction we can consider exhaustion of natural

resources, harming next generations' possibilities, altering eco-systems balance, for example deforestation, and ultimately the effects related to the extraction process, such as oil leaks during transportation and extraction.

2. as *output*: emitting waste other substances that harm the surrounding environment. The effects connected to the outputs of human activity are becoming more and more relevant to the average consumer, thanks to policies aiming to develop awareness about pollution problems. These results from production include greenhouse effect (causing global warming), ozone layer destruction, smog, toxic emissions, waste such as plastic in the oceans and main other minor effects.

Sustainable development works on these 2 groups of effects, focusing on preserving resources to limit the input effects and preventing waste and pollution concerning the output effects.

## 2.1 ROLE OF INNOVATION

Even though sustainable development appears to be a panacea for improving the environmental footprint of companies, it results necessary to underline that "*not all shifts to PSS result in environmental benefits: a PSS must be specifically designed, developed and delivered, if it is to be highly eco.efficient" (*Vezzoli et al., 2018, page. 48). According to Hall and Wagner, sustainable development offers considerable business opportunities, but it should not stop to incremental improvements. The two authors propose Schumpeter's idea of "creative destruction" (Schumpeter, 1934), according to which innovation should introduce inventions that change the market structure by making products and processes obsolescent (Hall, Wagner, 2011).

However, Schumpeter himself recognized that innovation is a difficult and expensive activity, consisting of "throwing out the old in favor of the new" (Schumpeter, 1934). As a matter of fact, Sustainable Development Innovation (SDI) comes with a higher than normal level of complexity and uncertainty due to the integration of economic, environmental and social dimensions (Matos and Hall, 2007). The level of uncertainty surely plays a complicated role in PSS innovation. Hellman (2007) highlights that, when talking about radical innovations,

uncertainty might derive from the immature state of technology development and from the the fact that it is not clear if and when the market will adopt the disruptive innovation (Hellman 2007). But how does a PSS cope with innovation? According to Vezzoli et al., the PSS innovation process consists in a linear model of innovation, a model which suggests that innovation is a "*sequence of activities that starts with the definition of a problem and ends with the commercialization of an end product*" (adapted from Vezzoli et al, 2014). So, following Vezzoli's et al.' idea, innovation in a PSS starts with the design of the product, since sustainability must be integrated in the core, being it a complex variable and not easily measurable (Vezzoli et al, 2014).

Many models have been developed in order to define the steps of innovation, with the aim to clarify and identify the key-points in sustainable development innovation. However, we will proceed in examining these methods and tools in the chapter 2.4, when talking about "System Design".

## 2.2 INNOVATION DRIVERS

As we said before, supported by Schumpeter's ideas, innovation is a difficult process, both human and technological resource-demanding and it does not guarantee an immediate positive feedback from the market. In this section we will discuss about the drivers and incentives that push companies to develop and implement PSS business models. The two main categories of drivers are divided based on the target, focusing on companies and customers. These drivers are needed by companies and customers since the main purpose of both these categories is profit. As a matter of fact, when we talked about benefits that come along with PSS models, we only referred to advantages in terms of sustainability and they targeted more the environmental aspect, rather than the economic. Most of the companies exploit innovation as a source of competitive advantage against other firms, innovating products in order to offer the best goods or innovating processes to offer the same products at a lower price (Hall and Wagner, 2011).
What we are going to discuss in this section, is the group of drivers that link companies' and customers' personal interests by explaining the advantages of innovating and shifting to a PSS.

### 2.2.1 DRIVERS FOR COMPANIES

Authors as Tukker and Tischer defined the main driver as the need to extend the customer target range by finding **new market opportunities** and, generally, **improve the competitive position** (Tukker and Tischner, 2006). Developed countries, with a more saturated economy, struggle against less developed countries with a lower cost of labour (Baines et al., 2007). In these scenarios, profit is being shred by price competition, reducing incentives for companies to operate in developed countries, favoring poor countries. As recognized by Mont, companies understood that it is not sufficient to clash over product quality or operational excellence, being these two factors extremely expensive and difficult to reach (Mont, 2004). Therefore, many companies decided to move vertically on the value chain, and instead worked on the strategic aspects of their products, integrating services in their offerings and creating competitive advantage from adding value to a "traditional" way of selling (Ceschin, 2014). In this case, the driver consists on the strategic advantage of operating in a different market, selling the satisfaction instead of the product and therefore captivating customers in a market composed by many segments.
The search for new market opportunities actually is correlated to the need to differentiate offers to adapt to customers' demands (Ceschin, 2014). According to UNEP, PSS models can potentially allow a shift from mass production and standardization to a personal customization business strategy, since each offer can be customized to satisfy each demand from the single customer (adapted from UNEP 2002).

Another strategic driver that operates in the process of shift to PSS is the financial difficulty of developing new technologies and produce enough products. As a matter of fact, PSS models are less capital intensive, since they strive on product re-use and recycling of materials/products/modular pieces (Ceschin, 2012).

According to Mont, another important driver is represented by the growing concern of stakeholders about environmental and social issues (Mont 2002a, Mont 2004). As we saw in the introduction of the chapter about sustainable development (chapter 2), companies that show in their value proposition that they take into consideration the environment tend to perform better, acknowledged by aware consumers (Hall and Wagner, 2011).

The drivers mentioned above are referred to a general PSS, not taking into consideration the three categories discussed in chapters 1.1.1, 1.1.2 and 1.1.3. As a matter of fact, there are some

advantages specific to each type of PSS, since in each there are win-win solutions (UNEP 2002):

- Product oriented: the win-win potential is achieved by
  - Minimizing costs for a long-lasting serviceable product;
  - Designing and developing products which consider the product's end-of-life;

- Use oriented: a company is incentivized to innovate a PSS in order to:
  - Maximize the use of a given product to meet need/demands,
  - Extend the life of the product and the materials used,
  - Increase the shared use leads towards an earlier replacement of the product and therefore better performance and more efficient solution, without generating an overall increase in production;
  - Improve the level of knowledge and specialization of the company, leading to economies of scale, economies of expertise and therefore an offer of better services;

- Result oriented: PSS innovation is driven by:
  - Minimization of energy and materials consumed since the profit is based on unit of satisfaction rather than unit sold;
  - More reliable and easy to repair/upgrade products postpone disposal costs and increase profitability;
  - Specialization and economies of scale generate more profits for each unit of satisfaction sold

### 2.2.2 DRIVERS FOR CUSTOMERS

One of the most interesting characteristics of a PSS business model is that it enables the possibility of a win-win situation, in which the company and the consumer benefit from this particular type of offering. The drivers pushing customers into buying a PSS are both economic and logistic. Mont states that customers expect reduced risks and liabilities associated with handling the product (Mont, 2002b). As a matter of fact, the company selling a PSS would take care of the logistics deriving from risks and liabilities of products, relieving the customer from this "burden". Furthermore, a PSS business model would take care of disposal practices instead of the consumer, reducing costs for both parts while operating in a more efficient way due to specialization (Mont, 2002b)

Moreover, through the acquisition of a PSS, a customer could be able to purchase a function that he would not be able to afford otherwise, since most of the times advanced technologies require a consistent initial investment to enable a certain standard of performance. Thus, many customers (or segments of consumers) could benefit from services thanks to the lower price and thanks to the absence of initial capital investments (for example solar panels) (Ceschin, 2011).

The nature of the product plays an important role as a motivation to switch to a renting or pay per use model, instead of buying in the traditional way. For example if there are very expensive products or goods that are not regularly used but require high maintenance costs (or even reduce storage space by being bulky), then customers tend to satisfy their needs by renting or activating services to make up for the lack of product (Mont, 2004)

## 2.3 BARRIERS TO PSS

Even though in the previous section the drivers to push companies towards PSS seemed numerous and valid, it is important to underline the fact that not all PSS end up necessarily more eco-efficient than other companies. As Vezzoli stated, "a PSS must be specifically designed, developed and delivered, if it is to be highly eco-efficient." (Vezzoli et al., 2018, page 48).

As in the case of drivers, barriers can be observed from the companies' perspective or from the customers' perspective.

### 2.3.1 BARRIERS FOR COMPANIES

Barriers for companies derive from a multitude of factors. First, adding environmental considerations to the product development usually increasing the length of the time to market. This effect is enlarged if we consider that the entire process of the PSS should be designed keeping in mind criteria of eco-efficiency (Mont, 2002b). Moreover, the product development in a PSS takes the relationship with customers and suppliers to another level by requiring higher standards of eco-efficiency, durability and customization (Mont, 2002b).

According to Vezzoli, another barrier is represented by the difficulty and uncertainty deriving from quantifying the economic savings and the impact-reduction from the PSS. This measurement is important to companies because it helps to advertise the positive impact of the PSS and have bigger incomes (Vezzoli et al., 2018).

Ceschin points out that a major obstacle is identified in the shift in the strategic approach the top management should embrace in order to face the fact that delivering a PSS is more complex process compared to the traditional product delivery (Ceschin, 2012).

Vezzoli and Manzini state that a company should accept changes in the corporate mindset in order to support properly the innovation, integrating new competences, skills and experience in order to face a different business model (Vezzoli, Manzini, 2002).

Another aspect that might restrain companies in shifting to a PSS would be the education needed to use a product with the needed level of care. Many consumers use parsimoniously their goods taking special care to not ruin them. This is a behavior that is not guaranteed to happen when customers have to deal with products that are not "theirs" but are rent: a careless over-use would cause a major damage and a quicker worn out of the good, leading to a worst scenario because of maintenance, disposal and repair costs (Ceschin, 2012). Mont points out that multiple and shared use doesn't necessarily lead to less impact on the environment: "*leasing, for example, can promote use of products which otherwise would not be affordable for customers. Without the option of leasing, the purchase could have to be postponed to a later date"* (Mont, 2002b, page 243). It proves to be difficult to say priorly if the PSS would benefit environmental conditions since it relies on consumers' behavior of use and companies need to educate costumers on the proper use of the product, limiting this way damages and costs deriving from careless use.

### 2.3.2 BARRIER FOR CUSTOMERS

The main problem regards customers' behavior: it is far more complicated to understand the consumer's buying behavior than expected. PSS works on the assumption that customers are more interested in the use or in the need satisfaction than they would be on the ownership of the product. This assumption however does not represent reality since many products are owned as a social status, symbolizing a person's wealthiness (adapted from Mont, 2002b).

White underlines that many customers lack a general understanding about life-cycle costs (White et al., 1999). Therefore the potential economic advantage represented by PSS might be hidden to those customers who are not aware about the maintenance costs that products require. This lack of awareness leads many customers to think that the cost of a PSS is actually similar to the traditional ownership, even though they do not take into account life-cycle costs and do not consider the fact that with a PSS the payment is based on the use made and not on the value of the product.

Another barrier for customers is represented by the actual state of infrastructures and technologies. In order to satisfy completely and at the same level of traditional buying methods, PSS require strong and efficient infrastructures to cope with the circulation of products among people, facilitating product collection and delivery (Vezzoli, Manzini, 2002).

## 2.4 SYSTEM DESIGN

After dealing with drivers and barriers to PSS innovation we will now discuss the system design at its core. But what do we mean when we talk about "design"? The "Word Design Organization" (WDO) gives us a definition of industrial design, "*Industrial Design is a strategic problem-solving process that drives innovation, builds business success, and leads to a better quality of life through innovative products, systems, services, and experiences"* (definition available at https://wdo.org/about/definition/ consulted on 19/02/2020).
This definition is important for this thesis because it reflects the importance of innovation and correlates environmental issues (better quality of life) to products, systems and services.
According to WDO then, industrial design is a process that starts at the core of the strategy of a company and integrates innovation. In the extended version of the Industrial Design definition, it states that "*…It links innovation, technology, research, business, and customers to*

*provide new value and competitive advantage across economic, social, and environmental spheres."* (WDO 2015)

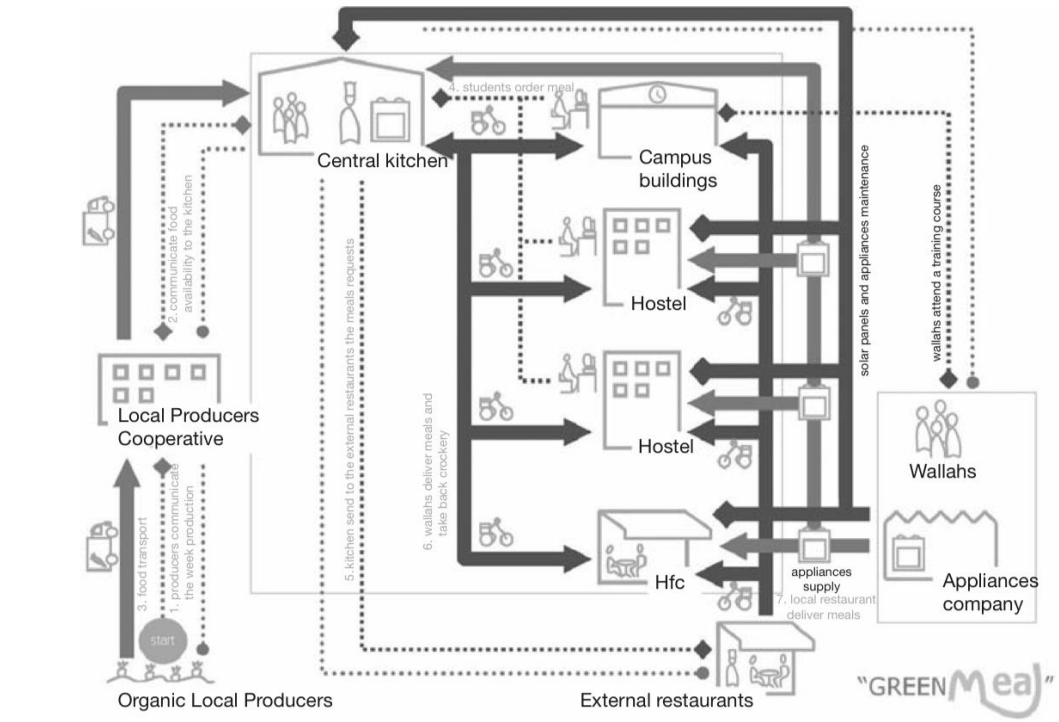
According to Vezzoli et al., **Product-Service System Design for Sustainability is**: *"the design of the system of products and services that are together able to fulfil a particular customer demand (deliver a 'unit of satisfaction') based on the design of innovative interactions of the stakeholders (directly and indirectly linked to that 'satisfaction' system) where the economic and competitive interest of the providers continuously seeks both environmentally and socio-ethically beneficial new solutions."* (Vezzoli et al., 2014)
From Vezzoli et al.'s definition, we understand that innovation should be driven towards a contemporary satisfaction of environmental, economic and socio-ethical criteria, keeping in mind customer's needs by involving customer through innovative interactions of stakeholders. However in order to achieve this integration, companies should adopt different approaches at the same time (Vezzoli et al., 2014):

- *Satisfaction-system approach*: the design should aim to satisfy a particular customer need (focusing on the satisfaction unit mentioned before);
- *Stakeholder configuration approach:* the design should take into account the different interactions that take place among stakeholders concerned by the PSS;
- *System sustainability approach:* this approach requires design and innovation to continuously search for eco-friendly, efficient, social equity and locally improving solutions to implement into the PSS.

The first approach requires companies to identify the need customers are looking to satisfy. After identifying the need, it is important to elaborate a way to measure customers needs in terms of satisfaction, introducing the so called "satisfaction units" (Vezzoli et al., 2018). The concept of satisfaction units focus on a wider range of stakeholders but at the same time aims to satisfy one final customer, substituting the ownership of the product. For example, we can consider the transportation: normally, a customer would buy a car to satisfy his need of transportation. A good satisfaction unit would be to measure the kilometers traveled per year and the consequential PSS would focus on allowing the customer to travel normally without owning a car, so in this case renting/sharing a car or using public transportation would have the same effect on the customer while avoiding the ownership of the car.

The second approach concerns all stakeholders involved, so recalling the example of the car the stakeholders would be the car manufacturers, car mechanics, the user, the company responsible

for insurance, maintenance, repair and disposal. Looking at the bigger picture, the PSS designer should promote innovative types of connections (like partnerships) linking all components involved in a system focused on a specific demand for satisfaction (Vezzoli et al., 2018).



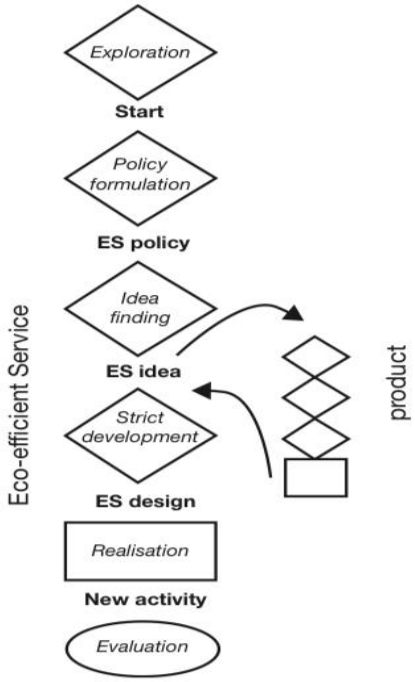

*"Figure 4: example of stakeholder system map, in this case showing the eating need satisfaction inside the university campus canteen. (Source Vezzoli et al., 2018)"*

The third approach focuses on the sustainable aspect of innovation in strategic design. Since interactions between producers and final customers increase in number, companies should design PSSs keeping in mind that to lower the cost and the environmental impact the product or service must be highly efficient, long-lasting, re-usable and recyclable (Vezzoli et al., 2018).

### 2.4.1 'DES' METHODOLOGY

In order to help designers in their integration process of all the approaches needed to design a S-PSS and to adopt a systematic approach, Brezel et al. have developed a methodology called "Design of Eco-Efficient Services" (DES) (Brezel et al., 2001). The process starts with an exploration phase where vision and goals are decided analyzing the environmental impact and identifying future users. The second step is about policy formulation, normally considering a Eco-efficient Service (ES) policy. Then the process proceeds with the *idea finding* together with

a “strict development” in order to achieve an ES idea and an ES design. The final steps are *realization,* in which the product is developed with regards to the previous steps and finally the company does an *evaluation* on the process and on the product (the steps are summarized in figure 5). Throughout the process, multiple analysis are done using assessment tools, as market research, strategy and policy tools (such as SWOT: Strengths, Weaknesses, Opportunities, Threats), environmental assessment tool (normally the META matrix is the most used, where META stands for: Material, Energy, Toxic substances and Added value) and tools to evaluate the product, as life-cycle assessment scenarios (Vezzoli et al, 2014).




“*Figure 5: DES methodology steps (Source: Brezel et al., 2001)”*

### 2.4.2 METHODOLOGY FOR SYSTEM DESIGN FOR SUSTAINABILITY

Another methodology used to design a system is the "Methodology for System Design for Sustainability (MSDS)" (Vezzoli et al., 2014). This approach is more recent and works similarly to the DES methodology. It starts with a *strategic analysis* in which informations are gathered with the aim to generate innovative sustainable ideas. In this first step the objectives are 2: to understand the current situation, the socio-economic context and dynamics inside the context while the second objective is to process information on which base the designing process. Cases of excellence for sustainability must be taken into consideration to analyze the criteria and winning factors composing these cases. (Vezzoli et al., 2014)

Then the methodology proceeds with *exploring opportunities*, i.e. making a list of environmentally oriented ideas. The aim is not to find incremental improvements at final product level but instead to discover radical innovations that work at a system level. The improvements must affect the three dimensions of sustainability, environmental, socio-ethical and economic. All information gathered during the previous step are used to develop a catalogue of promising strategic possibilities and therefore build different scenarios and confront them. (Vezzoli et al., 2014)

After gathering ideas and scenarios the next step is to *design system concepts,* in which one or more sustainable system concepts are developed. In this step stakeholders are involved to express their point of view. The ideas and scenarios are grouped to form different systems, defining products and services and identifying the actors who will be part of each system. (Vezzoli et al., 2014)

The next step is *designing system details*, in which the concepts from the previous step are engineered in detail. This means that each set of products and services will be developed and each particular will be refined to better suit its target of stakeholders. After defining the products, the next thing to do is quantify the resources required to develop them, produce and deliver them. In this stage the conclusive process is the assessment from the environmental, socio-ethical and economic point of view, checking if the developed scenario is suitable for sustainability and if it is able to satisfy in an efficient way customer satisfaction demand. (Vezzoli et al., 2014)

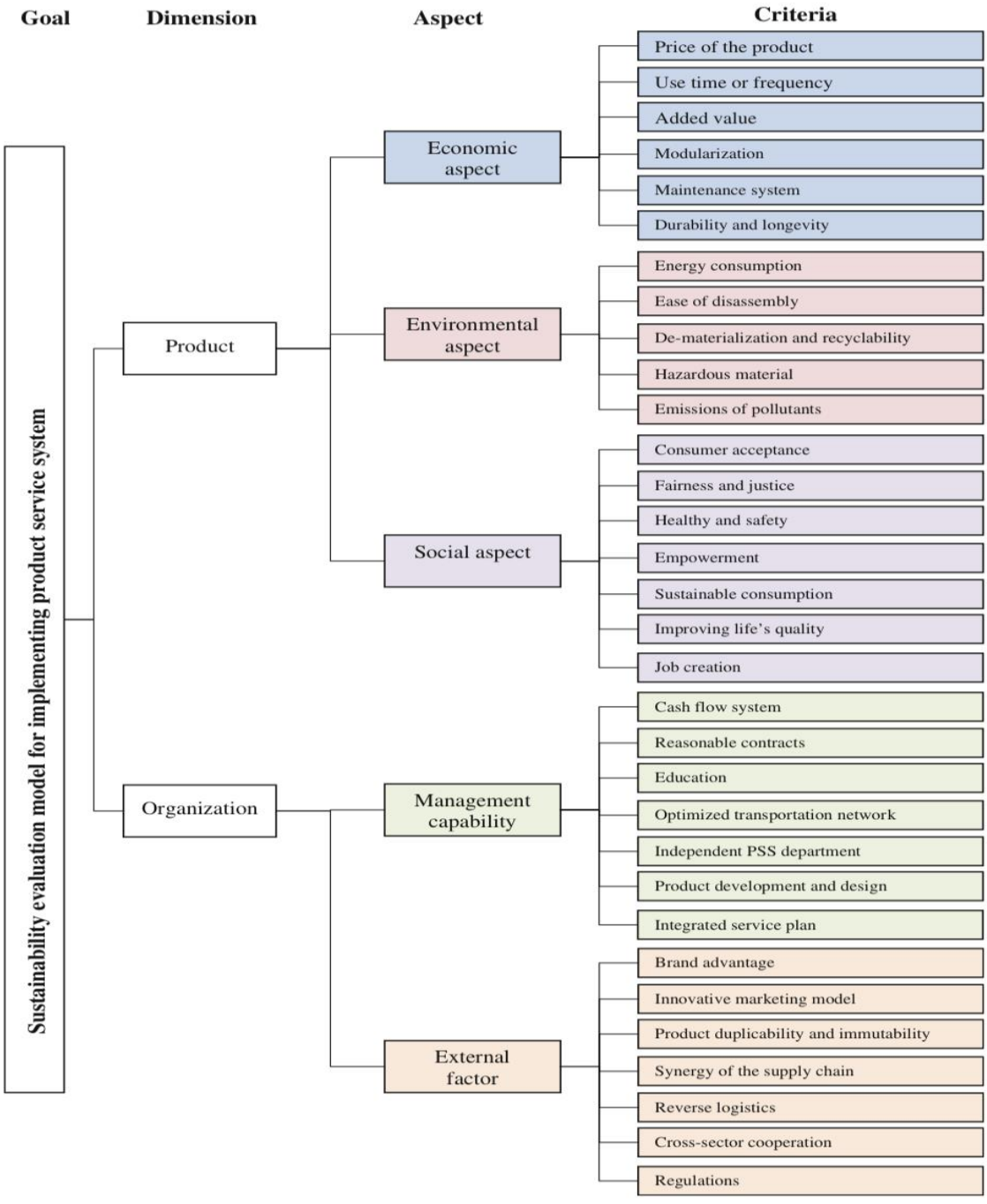
The last step is *communication*, that consists on preparing reports to communicate the sustainable characteristics of each system designed. However it would be wrong to think that communication starts at the final stage: in each step communication plays a vital role since each stakeholder must express their point of view in order to start sustainability integration in the earliest stages of system design. The main aim of this step is to provide a report which indicates the priorities for sustainable solutions, characteristics of the PSS, how sustainability was considered when designing the PSS. (Vezzoli et al., 2014) (the process is schematized in *table 1).*

| **Stage** | **Aim** | **Processes** |
|---|---|---|
| **Strategic analysis** | To obtain the information necessary to facilitate the generation of sustainable system innovation ideas | Analyze project proposers and outline the intervention context<br>Analyze the context of reference<br>Analyze the carrying structure of the system |
| **Exploring opportunities** | To make a 'catalogue' of promising strategic possibilities available or, in other words, a sustainability design-orienting scenario and/ or a set of sustainably promising system ideas | Outline a design-oriented sustainability scenario |
| **Designing system concepts** | To determine one or more system concepts oriented towards sustainability | Select clusters and single ideas<br>Develop system concepts |
| **Designing (and engineering) system details** | To develop the most promising system concept into the detailed version necessary for its implementation | Detailed system design |
| **Communication** | To develop the most promising system concept into the detailed version necessary for its implementation | Draw up the documentation for communications of sustainability |

"Table 1: Stages of MSDS methodology. (Source: adapted from Vezzoli et al., 2014)"

### 2.4.3 EVALUATION CRITERIA FOR PSS

After introducing some tools to use when designing a S-PSS, it is now time to discuss how the effectiveness of the system designed can be measured in all its sustainability components. Allen Hu et al. (2012) have given us a set of criteria to evaluate when analyzing the PSS. Each criterion is connected to the aspect it deals with and each aspect is related to the dimension of product or organization. The hierarchical map is shown in *figure 6*, starting from the aim to evaluate sustainability and then being sub-divided at each step.




"*Figure 6: Evaluation hierarchy of PSS (Source: Allen Hu et al., 2012)"*

The map shows that in order to assess the sustainability impact of a system, it is necessary to analyze both the organization delivering the PSS and the product itself in sub-factors, which consist on the triple bottom line for the product and a more specific subdivision for the organizational factors that affect the final result. From the work of Allen Hu et al., all criteria are explained in the following table (*table 2*)

| | **CRITERIA** | **CONTENTS** |
|---|---|---|
| Dimension of "Product" | | |
| **Economic aspect** | Price of the product | Price greatly affects consumers' willingness to use PSS, expensive products may hinder PSS |
| | Use time or frequency | If products are used infrequently or have short use time by customers PSS implementation will be affected |
| | Added value | Maintenance and reconditioning services may create competitive advantage for the producer, as well as increase customer retention. They can serve as an additional income source for manufacturers or retailers, and increase contact with customers |
| | Modularization | Modularity and standardization will tend to reduce time and cost |
| | Maintenance System | The maintenance system includes management, inspection, disassembly and reconditioning; they will all affect time and cost |
| | Durability and Longevity | A high durability and longevity allow products to be used by more customers, which reduces cost |
| **Environmental aspect** | Energy consumption | Energy consumption during use stage |
| | Ease of disassembly | Ease of disassembly can facilitate the separation of used parts and components for product recycling and remanufacturing |
| | De-materialization and recyclability | To form a closed loop, the use of resources and ease of recyclability should be important attributes for PSS |
| | Hazardous material | Avoid the use of harardouz substances during the PSS life cycle |
| | Emissions of pollutants | Minimize the emission of pollutants |

| | | |
|---|---|---|
| **Social aspect** | Consumer acceptance | Since it is linked to the reuse of products, the careful preparation of a special marketing strategy and customer acceptance is required |
| | Fairness and justice | Base on fairness and justice for labors rights and trade in supply chain |
| | Healthy and safety | Improve stakeholders' healthy and safety in full life-cycle |
| | Empowerment | Improve stakeholders' opportunities for participation, or the provision of new channels for residents toward decision-makers |
| | Sustainable consumption | Promote customers' sustainable consciousness to make more responsibility consumer behavior |
| | Improving life's quality | This is presumably due to the fact that in order to survive in the market, household services must first be socially beneficial to the users or can improve the quality of life of the consumers |
| | Job Creation | It is hoped that PSS can create new jobs, help secure existing ones, or help tackle long-term unemployment |

Dimension of "Organization"

| | | |
|---|---|---|
| **Management capability** | Cash flow system | PSS is different from the traditional business model; it needs a better management of cash flow |
| | Reasonable contracts | PSS emphasizes on long-term profitability, and hence a reasonable contract between the producer and the consumer is necessary for both |
| | Education | To succeed in implementing PSS, education for employees, suppliers, and retailers is necessary |
| | Optimized transportation network | Since the ownership of the product belongs to the producer, the transfer or transportation of products among consumers, producers, and retailers is necessary. Hence, the transportation cost becomes important. A well-planned transportation system can minimize the cost of PSS |
| | Independent PSS department | Since PSS is a different business model, a separate or independent department may need to be set up |
| | Product development and design | For PSS to work efficiently product development and design capability need to be enhanced |

| | | |
|---|---|---|
| | Integrated service plan | PSS may offer additional services in combination with different products to draw the attention of clients. These additional services could stabilize the relationship with customers |

| | | |
|---|---|---|
| **External factors** | Brand advantage | The company has a strong brand name associated with high quality, safety, and durability of products, which will facilitate a successful PSS |
| | Innovative marketing model | PSS is new to consumers, and hence it needs certain innovative marketing efforts, at least in the beginning when the whole concept is launched |
| | Product duplicability and immutability | The PSS provider should be able to create a unique system that cannot easily be copied or performed by other parties |
| | Synergy of the supply chain | The producer collaborates with its suppliers, and this usually helps in the creation of the synergy effect in both financial and environmental aspects |
| | Reverse logistics | In designing PSS, reverse logistics is needed because it can enhance the feedback among retailers, producers, and consumers |
| | Cross-sector cooperation | In many instances, the creation of a successful PSS requires the involvement of multiple actors across sectors such as the government, the producer, and the consumers |
| | Regulations | Regulations such as IPP, ERP, and others which are related to dematerialization may promote PSS |

*"Table 2: Evaluating hierarchy of product service system (Source: adapted from Allen Hu et al., 2012)"*

In order to achieve sustainability in all his dimensions, a firm proposing a PSS should analyze all these criteria and make an assessment on the product, evaluating the possible impact of the system during the strategic phase of designing. In the methodologies proposed before, this analysis should happen in the earliest stages. As a matter of fact, this scheme links the idea of sustainable development proposed by Vezzoli et al. (2014) that we discussed in chapter 2 to the factors related to the company's organization. By designing the PSS with these criteria as standards, a company should be able to deliver a S-PSS reducing the overall impact of the system and not only the product's one, as we stated in chapter 2.3 when we quoted Vezzoli et

al. stating that a PSS should be specifically designed to be eco-efficient in all dimensions (Vezzoli et al., 2018).

## 2.5 BEST PRACTICES

After explaining the concept of PSS, the sustainability dimensions, drivers and barriers that push and block from shifting to an ownerless system, it is now clear that the connection between Product-Service Systems and sustainability is not as defined and easy to understand as one person would assume. As we saw talking about system design in chapter 2.4, companies should not focus on their direct customers only, looking at the classical curve of demand but should always consider the variety of stakeholders involved in the process. Managing to satisfy the demand for a need and operate in a sustainable way taking into account the needs of different stakeholders, such as manufacturers and suppliers, is not an easy task.

EY's Europe and Africa "Team Sustainability" started a research to evaluate the current level of integration of sustainability, collecting questionnaires from 1524 professionals from different companies operating in different sectors. The companies were from Europe, North America, Centre and South America and Asia, in which 193 are Italian and 142 were classified as "leaders" of their sectors because of their performances. In this study EY's team showed how leaders tend to focus a lot on sustainability. All leaders proved to have invested into sustainable policies, defined objectives to reach sustainability and showing the highest levels of enthusiasm when talking about innovation for sustainability (EY, 2017). Furthermore, at page 17 the shift in corporate mindset becomes evident as leaders benefitted the most from sustainability: 48,6% of leader companies gained innovation of process and product from sustainability actions, a big number considering the mean of the statistical sample on this benefit is 18,4% (only 10,9% of the Italian companies gained this benefit). Other relevant data are represented by cost reduction, market differentiation and asset conservation, in which the percentage of leaders to have gained these benefits are respectively 41,5%, 35,2% and 32,4%, much higher than the average of 17%, 16,9% and 12,4% (the respective Italian percentage are 10,4%, 13,5% and 6.7%). (EY, 2017).

Some of the practices adopted by the leaders are (the first number in bold is leaders', second is average and third is Italian):

- Definition of policies for environmental impact reduction (**61,3%** - 31,5% - 35,2%);

- Definition and implementation of strategies with sustainability integrated (**80,3%** - 29,6% - 13,5%);
- Product innovation for sustainability (**54,9%** - 23,1% - 17,6%);
- Communication of the sustainability mindset inside and outside the company (**53,5%** - 22,6% - 28,5%);
- Strategically organizing the supply chain towards sustainability(**56,3%** - 22,2% - 8,3%);
- Assessment of environmental impact (**42,3%** - 16,3% - 10,9%);
- Product life-cycle assessment (**39,4%** - 15,7% - 8,3%);
- Publication of a a balance sheet that considers non financial information to evaluate the gains from the sustainability policy (**37,3%** - 14,5% - 7,8%);
- Design a specific plan for business continuity (**31,7%** - 12,9% - 4,7%);
- Develop initiatives of shared value(**28,9%** - 8,9% - 7,8%);

(EY, 2017)

The list shows some of the most common practices to start a sustainable mindset in a normal company. In the case of a PSS, sustainability should start at the core of the business model, being a key factor during the process of System Design.

Another underrated but relevant practice would be to educate the final customer about the correct use of the product, in order to avoid what Vezzoli et al. (2018) call “rebound effects” (Barquet et al., 2016).

# CONCLUSIONS

As we saw many times during the thesis, a Product-Service system requires a specific design, and many variables must be considered in order to develop a system that can simultaneously improve customers', manufacturers', stakeholders' and environmental conditions. A Sustainable PSS could potentially lead to major improvement in efficiency, resource consumption and product disposal, reducing our ecological footprint as Humanity and therefore increasing the quality of life. Furthermore, starting to think in a logic of "unit of satisfaction" instead of ownership to satisfy a need, companies might even be able to "*extend the enjoyable use of the product or connect the product more deeply to the consumer's identity construction*" (Vezzoli et al., 2014). On the other hand, as it was pointed out in the final chapters, it is necessary to sustain a change in the general mindset for customers, who should stop thinking about possessing goods and instead act towards the satisfaction of specific needs. As a matter of fact, we saw that each type of PSS contains different advantages that come along with win-win situations for companies selling the system, customers buying it and the surrounding environment, benefits such as efficiency in use, product durability, better disposal at the end of life, reduced volumes of production, less waste and so on. This means that customers should be involved and participate spontaneously in the system development, tagging alongside manufacturers, retailers and public institutions in order to exploit the various possibilities in terms of sustainability offered by Product-Service Systems.

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