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Proposal of a business model framework for PSS (Product-Service System) integrating a sustainability-oriented approach

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ABSTRACT

Industries are transforming their business strategy from a product-centred to a more service-centred nature by bundling products and services into integrated solutions. Such systems are commonly termed Product-Service Systems (PSS) and they are seen as an appealing strategy due to the possibility to augment profitability while at the same time become more sustainable. In order to articulate such strategies, proper business models are required. A business model describes the logic of the firm, the way it operates and how it creates value for its stakeholders.

The scope of this work is to design a Business Model Framework (BMF) proposal for PSS under a sustainability approach, which means the involvement of several stakeholders and the consideration of the three sustainability pillars (economic, environmental and social). Afterwards, a group of supporting tools (toolkit) is given to allow companies and interested people to develop a real business model based on the BMF for PSS.

The first step of the used methodology has been to do an extensive literature review on the state of the art of related concepts: sustainability, business ecosystem, PSS, business models, business model frameworks, services, value, value co-creation… Then, all these concepts have been merged to design the suitable elements for the BMF for PSS. Finally, in order to choose the most suitable tools to build the toolkit, a classification of a wide range of tools has been done with indicators and aggregated criteria. A presentation of each of the studied tools is included in the work.

Even the scope of this work has been somehow a novelty, a concise and clear BMF for PSS has been designed, dealing with all the most current trends of the issues reviewed; e.g.: life-cycle thinking, sustainable value, stakeholders' involvement, customer-centred approach… Then, in reference to the presented toolkit, it is practical and easy to use; but a need of more tools has been detected in the literature to properly develop some aspects of the BMF. Globally, the result has been satisfactory and the objectives have been properly achieved.

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LIST OF ABBREVIATIONS

BM: Business Model

BMF: Business Model Framework

LCVP: Life-Cycle Value Proposition

PSS: Product-Service System

1. INTRODUCTION

Globalisation and increasing demand from customers pose a challenge to industry and prompt it to become more sustainable. These challenges have been magnified with the recent economic crisis and they force industry to explore strategies to gain leverage. Industries are transforming their business strategy from a product-centred to a more service-centred nature by bundling products and services into integrated solutions. Such systems are commonly termed Product-Service Systems (PSS), and they are seen as good strategies to face today's competitive business environment.

The possibility to augment profitability while at the same time become more sustainable makes PSS an appealing development for manufacturing companies. But to succeed in the service industry, the manufacturing company will have to overcome many new obstacles.

In order to overcome these hurdles in a proper way, a suitable *business model* is required. A business model describes the rationale of how an organization creates, delivers, and captures value[1] – economic, social, or other forms of value. Today, innovation must include business models, rather than just technology and R&D. Business models matter. A better business model often will beat a better idea or technology. And whether they articulate it or not, every company has its own.

The research on defining a business model and its strategic patterns for those firms offering PSS (Product-Service Systems) is in its first stages, and this is exactly the aim of the present study. First, this work gives a review on PSS research; it explains business models features in a generic approach, and deals with relevant related topics attending to the state of the art. Secondly, it merges all the topics in order to design a business model framework for PSS. Finally, a low complex and easily accessible toolkit is presented to give companies, scholars and anybody interested in the topic a concise group of tools to run a PSS design project.

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[1] Definition given by Osterwalder & Pigneur (2010).

2. SCOPE AND LIMITS

This section concerns the description of the scope and boundaries of the work. The objectives intended to reach are presented, as well as those parts that are beyond the limits of the study.

There are two main scopes in this work:

1- To design a Business Model Framework (BMF) for Product-Service System (PSS) under a sustainability approach, that means the involvement of several stakeholders from the business ecosystem and the consideration of the three sustainability pillars (economic, environmental and social).

2- To give a toolkit or list of tools covering the main aspects of the BMF designed, in order to allow companies and interested people to develop a real BM (business model) based on the BMF for PSS.

Even though the structure or basic points of BMs might be the same, a BM is unique for every single company and features change from one to another. For this reason it is not possible to design a theoretic business model valid for any case. The minimum level of detail that can be reached with a theoretical approach is the business model *framework* or the basis of BMs for a specific type of companies. According to Teece (2010) good designs are likely to be highly situational, and the design process is likely to be iterative.

So from this discussion can be guessed that the goal is to fix the structure or basis for business models for PSS; i.e., a framework. It will be then that every single company taking as a reference the framework developed here will carry out its own business model, with the support of the tools given in the toolkit, or others the user may find useful.

3. LITERATURE REVIEW – STATE OF THE ART

In this chapter the literature review done is presented. The main elements reviewed are sustainability, business ecosystem, PSS (Product-Service System), business model and business model framework. The reasons to review PSS, business model and business model framework are obvious taking into account that they are the core part of this work. Then, due to the importance of sustainability within the PSS concept, and the importance to situate a business model within a business ecosystem, these two concepts are also reviewed. These connections between concepts are presented later in this section.

Research on each reviewed concept has been developed to find out the state of the art, and the most relevant contributions from several authors are included throughout this review – at least from our point of view and bearing the orientation of this work in mind.

3.1 SUSTAINABILITY. PILLARS AND DIMENSIONS

Sustainability is the capacity to endure, to keep in existence, to maintain (adapted from www.dictionary.com). For humans, sustainability is the long-term maintenance of responsibility and entails all levels of society (The Shorter Oxford English Dictionary). In the area of industrial practices, sustainability is gaining importance, as the range of stakeholders including consumers, customers, regulators, shareholders, nongovernmental organizations and public bodies are today demanding that companies address the sustainable issue in a more comprehensive way - (Arena *et al.*, 2009).

The concept of sustainability was first formulated in 1987 by the World Commission on Environment and Development, WCED; who stated that the goal of sustainability is to "*meet the needs of the present generation without compromising the ability of future generations to meet their own needs*". Later, in academic debates and business arenas, hundreds of definitions have been proposed referring to a more humane, more ethical and more transparent way of doing business (van Marrewijk, 2003).

Usually, literature refers to three pillars of sustainability: environmental, social and economic. Campbell (1996) stated that the three priorities (economical, social and environmental) resulted in three conflicts: '(i) "Grow" the economy, (ii) distribute the growth fairly, and (iii) in the process do not degrade the ecosystem'. However, this classification is very broad and therefore could not be sufficient to operationally support companies in

selecting a specific strategy. In Table 1 the dimensions for each of the three sustainability pillars are presented, according to Arena *et al*. (2009). Next some details are given.

Table 1 – Dimensions for sustainability pillars. (Source: Arena *et al.,* 2009).

Environmental	Social	Economic
Materials	Work practices and adequate working conditions	Economic performance
Energy	Diversity and equal opportunities	Market presence
Water	Relations with the community	Indirect economic impacts
Biodiversity	Social policy compliance	
Emissions	Consumer health and safety	
Waste	Human rights	
Product & Service		
Compliance		
Transport		

Environmental sustainability

Among the three traditional dimensions of sustainability, the environmental one has been widely investigated. It is possible to identify nine main sub-dimensions of environmental sustainability: materials, energy, water, biodiversity, emissions, waste, product & services, compliance and transports. Many contributions investigated the environmental dimension in terms of resources (water, materials, energy); consumption, depletion and pollution (biodiversity, emission and waste), and also dimensions concerning human behaviour and activities (product & service, compliance and transport).

Social sustainability

Moving to social sustainability, it is possible to underline six main sub-dimensions of analysis: (i) work practices and adequate working conditions, (ii) diversity and equal opportunities, (iii) relations with the community, (iv) social policy compliance, (v) consumer health and safety and (vi) human rights. However, "adequate working conditions" is the most quoted sub-dimension, showing the relevance of industry in sustainability. Any industrial activity is evolved in a community, so it is going to be affected in some way. Paying attention to the positivity of this effect is a way to be socially sustainable.

Economical sustainability

The classical approach to economical sustainability for a company is to operate in a proper manner in order to be able to maintain its activity in the long term. But economical sustainability entails broader aspects, and can be classified according to three main issues: (i) economic performance, (ii) market presence and (iii) indirect economic impacts.

3.2   BUSINESS ECOSYSTEM APPROACH

Considering the world around us, dozens of organizations collaborate across industries to bring electricity into our homes. Hundreds of organizations join forces to manufacture and distribute a single personal computer. Thousands of companies coordinate to provide the rich foundation of applications necessary to make a software operating system successful. Many of these organizations fall outside the traditional value chain of suppliers and distributors that directly contribute to the creation and delivery of a product or service.

Iansiti & Levien (2004) use business ecosystem as an analogy (like Moore, 1996; Power & Jerjian, 2001), which can help to describe and understand certain issues. They state: "*We found that perhaps more than any other type of network, a biological ecosystem provides a powerful analogy for understanding a business network. Like business networks, biological ecosystems are characterized by a large number of loosely interconnected participants who depend on each other for their mutual effectiveness and survival. And like business network participants, biological species in ecosystems share their fate with each other. If the ecosystem is healthy, individual species thrive. If the ecosystem is unhealthy, individual species suffer deeply. And as with business ecosystems, reversals in overall ecosystem health can happen very quickly.*" According to them, features of a business ecosystem include fragmentation, interconnectedness, cooperation and competition. It should, however, be pointed out that there are differences between natural and business ecosystems. First of all, in business ecosystems the actors are intelligent and are capable of planning and forecasting the future. Secondly, business ecosystems compete over possible members. Thirdly, business ecosystems are aiming at delivering innovations, whereas natural ecosystems are aiming at pure survival. From their point of view, a business ecosystem includes, for example, companies to which business functions are outsourced, institutions that provide with financing, companies that provide the technology needed to carry on the business, and producers of complementary products that are used in conjunction with those produced by a company. It even includes competitors and customers, when their actions and feedback affect the development of the products or processes. The ecosystem also comprises entities like regulatory agencies and media that can have a less immediate, but just as powerful, effect on companies.

According to Iansiti & Levien (2004), drawing the precise boundaries of an ecosystem is an impossible and, in any case, academic exercise. Companies should rather try to systematically identify the organizations with which their future is most closely intertwined and determine the dependencies that are most critical to the company. Anyway Power &

Jerjian (2001) state that you cannot manage a business on its own, but you have to manage an entire ecosystem.

Moore (1996) defines business ecosystem as "*an economic community supported by a foundation of interacting organizations and individuals – the organisms of the business world*". In another instance Moore's definition is somewhat different. Business ecosystem is an "*extended system of mutually supportive organizations; communities of customers, suppliers, lead producers, and other stakeholders, financing, trade associations, standard bodies, labor unions, governmental and quasigovernmental institutions, and other interested parties. These communities come together in a partially intentional, highly self-organizing, and even somewhat accidental manner*" (Moore, 1998). First definition highlights interaction within a business ecosystem, while the second one emphasizes decentralized decision-making and self-organization (Peltoniemi & Vuori, 2004).

According to Moore (1996) the aspects of an ecosystem are: actors, relations between actors, performance, dynamics and strategies and behaviour of actors. Furthermore there are seven types of actors in the ecosystem: customers, markets, products, processes, organizations, stakeholders and government/society.

Peltoniemi & Vuori (2004) consider a business ecosystem to be a dynamic structure which consists of an interconnected population of organizations. These organizations can be small firms, large corporations, universities, research centres, public sector organizations, and other parties which influence the system. Business ecosystems should be self-sustaining. This means that no government interventions would be needed in order to survive in local or global markets. Business ecosystem develops through self-organization, emergence and coevolution, which help it to acquire adaptability. In a business ecosystem there is both competition and cooperation present simultaneously.

Business ecosystems are considered complex systems, understanding them as "*systems with many different parts which, by a rather mysterious process of self-organization, become more ordered and more informed than systems which operate in approximate thermodynamic equilibrium with their surroundings*" (Peltoniemi & Vuori, 2004). On the other hand, "*complex systems contain many relatively independent parts which are highly interconnected and interactive*" (Cowan, 1994). The complexity aspects appearing in business ecosystems are self-organization, emergence, co-evolution and adaptation. They are presented in the following:

- **Self-organization**: it is defined as a process in which novel structures or features arise in a system without the intervention of an outside or inside controller. Self-organization is an ongoing process since it will never have completed its final outcome. Novelty is the contribution of self-organization and it can be specified in various ways in different systems. The lack of an outside or inside controller is the key to self-organization. It is the "self" that organizes. (Peltoniemi & Vuori, 2004).

- **Emergence**: the result of self-organization. *"This refers to the way the interactions among system components generates unexpected global system properties not present in any of the subsystems taken individually"* - (Casti, 1997).

- **Co-evolution:** Co-evolution appears in business ecosystems as the evolution of one company affecting the evolution of other companies - (Peltoniemi & Vuori, 2004).

- **Adaptation:** The whole ecosystem adapts to the external constraints. For example, governmental restrictions, taxes and tariffs are those constraints, which are set by the other party and are not very likely to change by co-evolution. When the environment changes, a business ecosystem adapts to changed conditions by emergence, co-evolution and self-organization - (Peltoniemi & Vuori, 2004).

Shareholders vs. Stakeholders

It is a good point now to discuss the terms of *shareholders* and *stakeholders*, as they are part of the business ecosystem and from now on they will appear in this work. Many articles deal with these terms but without giving a solid definition. Here is going to be presented the approach given in a website[2], for its clarity.

A shareholder is simply an individual, organization, or company that legally own share(s) of stock in a joint-stock company. By owning shares of stock, a company's shareholders collectively own the company itself and therefore have the right to vote on decisions that affect how the company is run. This usually means the shareholders, as partly owners, will push for company actions that increase their own financial returns.

To make an analogy, stakeholder and shareholders are like sparkling white wine and champagne. All champagne is sparkling white wine, but not all sparkling white wine is

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[2] http://dowelldogood.net/?p=545 (16/07/2012)

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champagne. Similarly, all shareholders are stakeholders, but not all stakeholders are shareholders[3].

A stakeholder is anyone that can be affected by a company's actions, objectives, and policies. This includes both internal stakeholders, such as employees, managers and shareholders, and external stakeholders, such as suppliers, customers, surrounding communities, creditors, the government, to name a few. (Adapted from the same website[3]).

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[3] http://dowelldogood.net/?p=545 (16/07/2012)

3.3   PRODUCT-SERVICE SYSTEM

3.3.1   Definitions and main characteristics

Traditionally, according to Morelli (2003), many people have considered products separately from services as two independent issues. However, recent years have seen the 'servitisation' of products and the 'productisation' of services. Morelli (2003) sees 'servitisation' as "*the evolution of product identity based on material content to a position where the material content is inseparable from the service system*", and 'productisation' as "*the evolution of the services component to include a product or a new service component marketed as a product*". The convergence of these trends is the consideration of a product and a service as a single offering – constituting what is often called 'a solution' that considers the overall functionality to be delivered. This 'solution' or Product-Service can be thought as a market proposition that extends the traditional functionality of a product by incorporating additional services.

Product-Service System is this 'solution' and all the system involved in providing this solution. System-approach is essential as it defines how tangible and intangible parts are combined and provided to customers. According to Baines *et al*. (2007) a Product-Service System (PSS) is generally interpreted as a *product(s) and a service(s) combined in a system to deliver required user functionality in a way that reduces the impact on the environment*. Goedkoop *et al.* (1999) add further clarity defining the key elements of a PSS; namely the following.

1. Product: a tangible commodity manufactured to be sold. It is capable of 'falling on your toes' and of fulfilling a user's needs.
2. Service: an activity (work) done for others with an economic value and often done on a commercial basis.
3. System: a collection of elements including their relations.

A product-service system could be defined as consisting of tangible products and intangible services designed and combined so that they jointly are capable of fulfilling specific customer needs (Tischner *et al.*, 2002). Many see PSS as an excellent vehicle to enhance competitiveness and to foster sustainability simultaneously (Tischner *et al.*, 2002).

According to Tukker (2004) a PSS business model allows firms to create new sources of added value and competitiveness, since they
- fulfil client needs in an integrated and customized way, hence allowing clients to concentrate on core activities,

- can build unique relationships with clients, enhancing customer loyalty, and
- can probably innovate faster since they follow their client needs better.

According to Oliva & Kallenberg (2003) transitioning from product manufacturer into service provider constitutes a major managerial challenge. Services require organizational principles, structures and processes new to the product manufacturer. Not only are new capabilities, metrics and incentives needed, but also the emphasis of the business model changes from transaction- to relationship-based. To explore firms' transitions, Oliva & Kallenberg (2003) structured their thinking along a continuum from pure-product to pure-service providers, and thought of manufacturing firms moving along that axis as they incorporated more product-related services. At the left extreme there is the pure-product position. At the right extreme it is situated a service organization for which their products are only a small part of their offering.
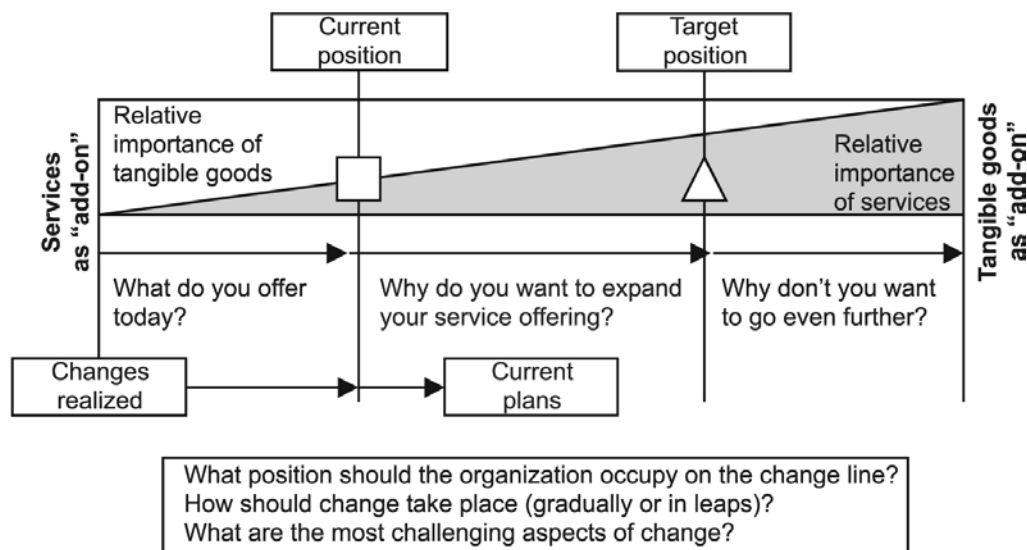
Figure 1 – The product-service continuum. (Source: Oliva & Kallenberg, 2003).

At the right extreme the emphasis is on the 'sale of use' rather than the 'sale of product'. The customer pays for using an asset, rather than its purchase, and so he benefits of restructuring the risks, responsibilities, and costs traditionally associated with ownership.

The following example illustrates a particular form of PSS that is popular within the literature. First it is considered the traditional purchase of a photocopier. As illustrated in Fig. 2(a), the manufacturer provides the technology and, provisionally, the servicing of the technology in the field. In return they are rewarded financially. Although the customer seeks only to use the asset, to do so they have to purchase the equipment (asset) first and then

provide the consumables, monitor performance, arrange servicing, and take responsibility for equipment selection and equipment disposal. The responsibilities of ownership lie with the customer.

With the PSS modality chosen here, asset ownership is not transferred to the customer (Fig. 2(b)). Not all types of PSS involve not transferring ownership to the customer (see section 3.3.2 for further information). In the case of the photocopier, the producer would typically provide 'a document management solution'. Then the producer, rather than the customer, would select and provide the equipment and consumables, monitor performance, and carry out servicing and disposal. In return they receive payment as the customer uses the printing capability. It is worthy to stress that the willing of the customer was only to use the asset and make photocopies, and not to own a photocopier neither to deal with all the ownership-related problems.
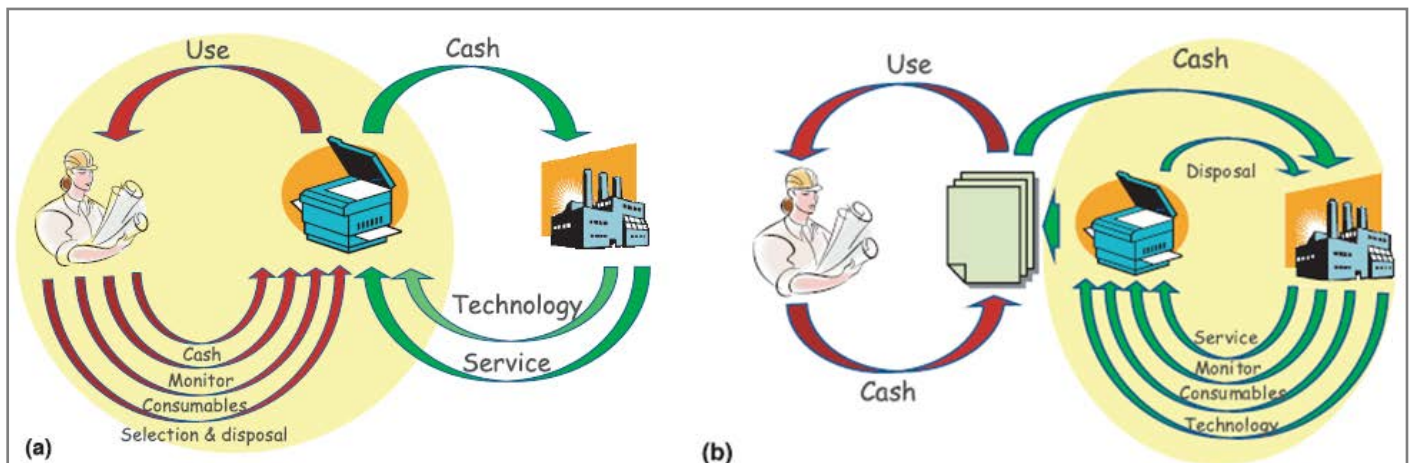
Figure 2 – (a) Traditional purchase of a photocopier; (b) Purchase of a document management capability. (Source: Baines *et al.*, 2007).

3.3.2   Classification of PSS

Though different authors use different labels and different subdivisions to describe PSS forms, there is some convergence on the existence of three different PSS types (Baines *et al.*, 2007), those identified by Cook (2006):

1. **Product-oriented PSS**. It consists in promoting/selling the product in a traditional manner, while including in the original act of sale additional services such as after-sales service to guarantee functionality and durability of the product owned by the customer (maintenance, repair, re-use and recycling, and helping customers optimize the application of a product through training and consulting). The selling company is motivated to introduce a PSS to minimize costs for a long-lasting, well-functioning

product and to design products to take into account product end-of-life (re-usable/easily replaceable/recyclable parts).

2. **Use-oriented PSS**. It consists in selling the use or availability of a product that is not owned by the customer (e.g. leasing, sharing). In this case the company is motivated to create a PSS to maximize the use of the product needed to meet demand and to extend the life of the product and materials used to produce it.

3. **Result-oriented PSS**. It consists in selling a result or capability instead of a product (e.g. web information replacing directories, selling laundered clothes instead of a washing machine). Companies offer a customized mix of services where they maintain ownership of the product and the customer pays only for the provision of agreed results.

All three types of PSS solutions aim at satisfying customer needs through a combination of products and services that are systemised to deliver the desired utility or function. However, the result-orientated model is more sophisticated and represents the most popular interpretation of the features of a PSS (Baines *et al.*, 2007).

However, each category includes PSSs quite different types. To go into detail, Tukker & van Halen (2003) reclassified these three categories into eight PSS sub-categories although they use the term 'services': product-, use- and result-oriented services.

Product-oriented services

- **Product-related services**. In this case, the provider not only sells a product, but also offers services that are needed during the use phase of the product. This can imply, for example, a maintenance contract, a financing scheme or the supply of consumables, but also a take-back agreement when the product reaches its end of life.

- **Advice and consultancy**. Here, in relation to the product sold, the provider gives advice on its most efficient use. This can include, for example, advice on the organizational structure of the team using the product, or optimizing the logistics in a factory where the product is used as a production unit.

Use-oriented services

- **Product lease.** Here, the provider has ownership and is also often responsible for maintenance, repair and control. The lessee pays a regular fee for the use of the

product; in this case normally he/she has unlimited and individual access to the leased product.

- **Product renting or sharing.** Here also, the product in general is owned by a provider who is also responsible for maintenance, repair and control. The user pays for the use of the product. The main difference to product leasing is, however, that the user does not have unlimited and individual access; others can use the product at other times. The same product is sequentially used by different users.
- **Product pooling.** This greatly resembles product renting or sharing. However, here there is a simultaneous use of the product.

Result-oriented services

- **Activity management/outsourcing.** Here a part of an activity of a company is outsourced to a third party. Since most of the outsourcing contracts include performance indicators to control the quality of the outsourced service, they are grouped here under result-oriented services.
- **Pay per service unit.** The PSS still has a fairly common product as a basis, but the user no longer buys the product, only the output of the product according to the level of use. Well known examples in this category include the pay-per-print formulas now adopted by most copier producers. Following this formula, the copier producer takes over all activities that are needed to keep copying function in an office available (i.e. paper and toner supply, maintenance, repair and replacement of the copier when required).
- **Functional result.** Here, the provider agrees with the client the delivery of a result. This category is used in contrast to activity management/outsourcing, for a functional result in rather abstract terms, which is not directly related to a specific technological system. The provider is, in principle, completely free as to how to deliver the result. Typical examples of this form of PSS are companies that offer to deliver a specified 'pleasant climate' in offices rather than gas or cooling equipment, or companies that promise farmers a maximum harvest rather than selling pesticides.

Going from the first to the last of these eight types of PSS, the reliance on the product as the core component of the PSS decreases and the need of a client is formulated in more abstract terms. The closer a PSS is to functional result, the more freedom has the provider in fulfilling the true final need of the client. However, abstract demands are often difficult to translate into concrete (quality performance) indicators, which make it difficult for the providers to

determine what they have to supply, and difficult for the clients to know whether they have got what they asked for.

Oliva & Kallenberg (2003) present a classification of product-related services moving along two dimensions. (See Table 2).

- Dimension 1 (vertical axis of Table 2): Change of customer interactions from transaction- to relationship-based. This shift changes the way the service is priced. From a mark-up for labour and parts every time a service is provided, to a fixed price covering all services over an agreed period. A consequence of this last form of contracting is that the service provider assumes the risk of equipment failure.

Table 2 – Classification of product-related services. (Source: Oliva & Kallenberg, 2003).

	Product-oriented services	End-user's process-oriented services
Transaction-based services	*Basic installed base services* Documentation Transport to client Installation/commissioning Product-oriented training Hot line/help desk Inspection/diagnosis Repairs/spare parts Product updates/upgrades Refurbishing Recycling/machine brokering	*Professional services* Process-oriented engineering (tests, optimization, simulation) Process-oriented R&D Spare parts management Process-oriented training Business-oriented training Process-oriented consulting Business-oriented consulting
Relationship-based services	*Maintenance services* Preventive maintenance Condition monitoring Spare parts management Full maintenance contracts	*Operational services* Managing maintenance function Managing operations

- Dimension 2 (horizontal axis of Table 2): Change of the focus of the value proposition to the end-user from product efficacy – where the product is the centre of the value proposition – to the product's efficiency and effectiveness within the end-user's process – where the product becomes part of the offering.

In the context of PSS Vasantha *et al.* (2011) present a classification of services in two different groups: they can be classified by the 'traditional' and 'broader' perspectives. In the traditional approach, a service is a set of activities which intends to keep products

functionally available. Such services can be maintenance, repair, overhaul, upgrade or other technical services. In a broader perspective, a service is a set of activities which intends to satisfy customer value. If the product is already matured, then the traditional perspective is usually more appropriate. If the product is in the early stages of development, then the broader approach offers more advantages, for instance the context for considering environmental influences, the possibility of substitution between tangible and intangible objects, or considering co–creation (creation with customers' and other companies involvement – see more on *value co-creation* in 3.4.4.2). The emphasis of the process of co-creation is more adapted to the broader approach because of the search of value for several stakeholders. Service characteristics variations through the two approaches are presented in Table 3.

Table 3 – Service characteristics variations through the two approaches. (Source: Vasantha *et al.*, 2011).

Characteristics	Traditional approach	Broader approach
Primary objective	Functionally available product. Fit for use	Satisfaction of customer value
Applicability	Matured product	Initial stages of development
Properties	Intangible, heterogeneous, inseparable, perishable, realised and consumed simultaneously	Derived from customer value. Yet to define concretely
Stakeholders involvement	Co-operation in terms of information transfer and usage analyses	Co-creation should be considered primarily
Degree of freedom	Restricted and focused to operational factors	Wider scope with opportunities to substitute between tangible and intangible objects
Evaluation criteria	Uptime, failure rate and severity of failures	User experiences and expectations

3.3.3   Advantages of a Product-Service System approach

As it would be explained along this section, the PSS concept has the potential to bring about such changes in production and consumption patterns that might accelerate the shift towards more sustainable practices and societies. According to some authors, the concept might be promising for companies, governments, and customers (White *et al.*, 1999); in other words, for several stakeholders.

3.3.3.1   *PSS and Sustainability. General relations.*

To some authors the concept of a PSS also embraces sustainability (Baines *et al.*, 2007). Sustainability, at first, is not inherent in PSS definition, but many authors have converted it into an inseparable and fundamental item of PSS. Some authors also find that sustainability is emerging as a significant competitive dimension between companies (e.g. Gutowski *et al.*,

2005). The following table shows a list of sustainability aspects within PSS that authors mention.

Table 4 – Literature references about sustainability in PSS characteristics. (Source: Vasantha *et al.*, 2011).

Author (Year)	Aspects connecting PSS & Sustainability
Tomiyama (2001)	Dematerialisation[4] of products requires enriching service contents.
Morelli (2002)	Emphasized the social aspect of PSS during the use phase.
Alonso-Rasgado *et al.* (2004)	Stressed the importance of re-use and remanufacturing of hardware for sustainable design.
Aurich *et al.* (2006)	They stressed the potential of technical services for more sustainable production and consumption.
Morelli (2006)	Considered PSS as fundamental for the development of solution-oriented partnerships, and consequently for sustainable solutions.
Kimita *et al.* (2009)	PSS affords opportunities for manufacturers to differentiate their products by meeting diversely segmented customer needs in a sustainable manner.
Maussang *et al.* (2009)	They stressed the necessity to take into account the environmental, economical and social aspects of PSS regarding sustainable development issues.
Meier *et al.* (2010)	Inscribed IPS^2 (Industrial Product-Service System) in the search for technological and economical potential that increase the competitiveness and harmonize the ecology and economy in one target system.
Tan *et al.* (2010)	Stated that PSS approaches are sustainable innovation strategies in a total life-cycle perspective.

According to Nidumolu *et al.*, (2009) there is no alternative to sustainable development. Sustainability is not the burden on bottom lines that many executives believe it to be. In fact, becoming environment-friendly – for instance – can lower costs and increase revenues (Nidumolu *et al.*, 2009). That's why sustainability should be a touchstone for all innovation. In the future, only companies that make sustainability a goal will achieve competitive advantage. (Nidumolu *et al.*, 2009).

For manufacturers, the potential to use their technical knowledge to find ways to deliver same or better value-in-use while using less energy or material is said to offer the potential to reduce cost – as well as environmental impact (Baines *et al.*, 2007). Next, sustainability in PSS is analyzed in its three pillars – environmental, social and economical.

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[4] Tomiyama (2001) understands *dematerialisation* as a means to decouple economic growth from consumption of energy and materials. After a review of authors dealing with *dematerialisation,* Baines *et al.* (2007) refers to it as the opportunity that the PSS offers to break the link between value delivered to the customer/user and the amount of physical material needed to create the value.

PSS vs Environmental Sustainability

According to Colen & Lambrecht (2010), PSS is a market compatible way of reshaping the manufacturer's strategy towards more sustainability. Many believe that the offering of PSSs launches considerable savings in material and energy consumption (Colen & Lambrecht, 2010). As providers take over after sales activities, they become responsible for such things as waste disposal, component replacement and energy use. With the right contractual incentives providers will incorporate after sales resource use in their decision making, effectively reducing the environmental impact during the entire life-cycle of the equipment.

The development of PSSs helps companies comply with and even surpass increasing environmental obligations. In practice it is observed the launch of energy saving services, refurbishment and recycling activities and efforts to increase the reliability of equipment. (Colen & Lambrecht, 2010).

A striking example is the study of Guajardo *et al.* (2009) proving that the reliability of airplane engines increased with 10 to 25% for PSSs with an adequate incentive structure. The increased reliability of machinery limits the consumption of raw materials and the amount of shipping, validating the environmental benefits of PSS.

The incentive structure is an important element in the development of PSSs (Colen & Lambrecht, 2010). Without the additional offering of services, a sales transaction also leads to a hand-over of responsibilities from the provider to the customer. After the sale, the customer becomes the bearer of all costs involved with the use and disposal of the equipment. Although customers will take the total cost of ownership into account when making purchasing decisions, it is only when the manufacturer is actively involved in after sale service that true compatibility of incentives occurs. Environmental benefits can be a consequence of this compatibility of incentives; in terms of improvement of designed products, more long-lasting products, and reduction of the amount of waste material throughout the life-cycle of the product, for instance.

By using a service to meet some needs rather than a physical object, more needs can be met with lower material and energy requirements over the whole life-cycle. So, product-service system usually has a remarkable influence on the design of the product, mainly on all that concerning to the entire product life-cycle. Moreover, some authors add that the value of product throughout their life-cycles has to be balanced against cost (Hara *et al.,* 2009; Tan *et al.*, 2010). The following figure shows the influence of product-service systems over the product life-cycle and the environmental benefits, according to UNEP (2001).
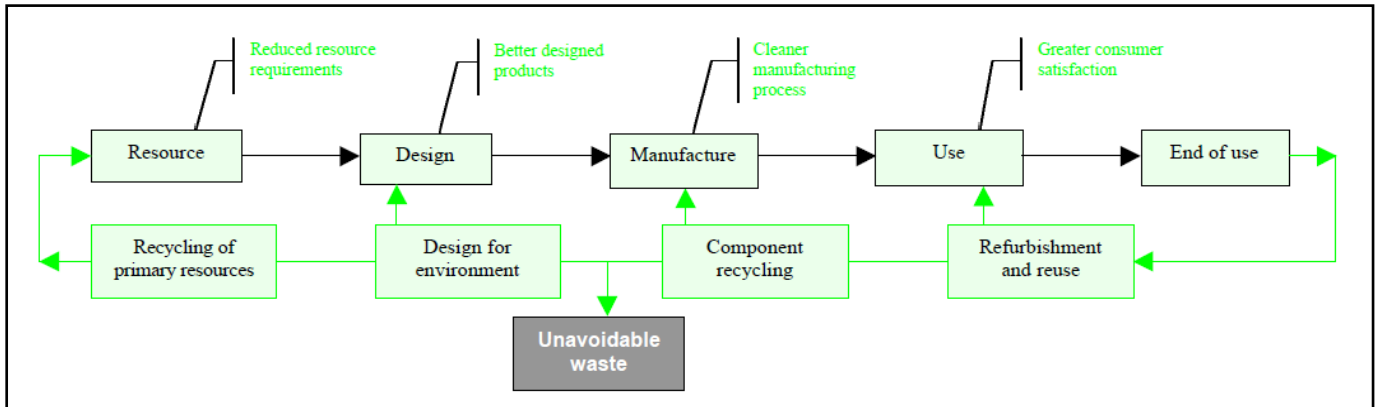
Figure 3 – PSS over the product life-cycle. Source: UNEP (2001).

PSS vs. Social Sustainability

With regard to social sustainability, with its wide range of items, the direct relation with PSS may not be so obvious. Establishing cooperative partnerships is quiet clear that benefits the different parties. To build a sustainable relationship in a competitive and challenging environment, manufacturers should create enough confidence for the customers and undertake and manage the larger risks and uncertainties (Ng & Yip, 2009).

However, the anachronistic idea that improving social aspects – as relations with the community, equal opportunities, find a balance between work and home life for employees… – is only a problem for the company must be changed. Social considerations include social value and recognition (Maussang *et al.,* 2009). It is an opportunity to do things well. These types of policies become quickly well-known by the community, and this is unbeatable publicity that can lead to a sales increase, employees' fidelity, or more people willing to take part of the team, just to mention a few possible consequences.

Insisting on the social nature of PSS and its location within a business ecosystem, it is interesting the contribution of Morelli (2006). A PSS is a social construction, based on ''attraction forces'' (such as goals, expected results and problem-solving criteria) which catalyze the participation of several partners. A PSS is the result of a value co-production process within such a partnership. Its effectiveness is based on a shared vision of possible and desirable scenarios.

Morelli (2006) states that relevant social groups are not only those groups that actively participate to the development of the product-service system, but also those groups and actors that indirectly participate in such a process or even those actors that may oppose to

the PSS. Such a perspective helps defining a complex picture of the scenario in which the PSS is supposed to be developed.

To exemplify a case of social value, Mercadona: a Spanish supermarkets chain, leader in Spain, in the 15th position in the international ranking (Deloitte, 2010) and the second company in growing terms within its sector. As a general purpose Mercadona aims at satisfying all the interested parts: customers, employees, providers, society and shareholders. It was the first Spanish firm to have an ethic audit and it has several social policies as the night noiseless unloading of the trucks. From 2007 to 2009 neighbours' complaints passed from 1008 to 418 complaints per year. (Amat & Valls, 2010).

PSS vs. Economic Sustainability

In a service-based economy, satisfying individualized customer needs to play a vital role rather than focusing on mass-production and consumption. Customers are more interested in availability or capability rather than purchasing physical artefacts (Ministry of Defence, 2005). Within this context manufacturers add value by including various services within their offerings. PSS is claimed to provide strategic market opportunities and an alternative to standardization and mass production (Baines *et al.,* 2007). Servitisation has emerged essentially due to decreasing demands for products, that become less attractive, and from lower profits gained from selling products (Vasantha *et al.,* 2011).

Services are attractive because they are characterized by high margins, stable revenues and high quality service will promote new equipment sales (Wise & Baumgartner, 1999; Visnjic & Van Looy, 2009). According to Colen & Lambrecht (2010) it seems almost undeniable that servicing the installed base is indeed a profit boon for manufacturers.

The main advantage of the PSS in the industrial/economic domain is to lock the costumer into a long-term relationship (Vandermerwe, 2000). This transformation provides other advantages, such as the difficulty for competitors to copy or imitate the service (Mont, 2000; Alonso-Rasgado *et al.,* 2004) and improved knowledge through better insight of product use (Alonso-Rasgado *et al.,* 2004). Oliva & Kallenberg (2003) specify that integrated solutions are a lasting source for differentiation, as they are less easy to copy.

Within the providers' organizations, the responsible for services will act to reduce the total cost of servicing the equipment. Because of the prolonged responsibility of the provider, both the customer and the provider will thrive to lower the costs over the total life of the

equipment. If the provider succeeds in reducing the total cost of servicing below the do-it-yourself costs of the customer, value is created by delivering these services.

This increased value is often called "service gain". The creation of a service gain is crucial for the success of the PSS, as only then a win-win situation becomes possible. A customer being able to reduce his total cost of ownership by purchasing services will do so, while the provider will offer services as long as they are profitable.

Beside these service profits, the provider will reap additional benefits as mentioned before. The incorporation of the costs of usage and disposal in the operations of the provider creates stronger incentives to lower the costs of ownership to the benefit of the customer, the manufacturer and the environment. How the service gain will be divided among the parties and how benign the value-enhancing services are for the environment depends on the scope and pricing of the service contracts (Colen & Lambrecht, 2010).

3.3.3.2   *Creating Value for Different Stakeholders*

Product-Service systems require a coordinated approach by several groups of stakeholders. The ideal of PSS development is that all three stakeholder groups – customer, company and society – benefit from the service systems related to each one of these groups, rather than simply one of them (McAloone & Andreasen, 2002).

Industry, governments and civil society need to work together to create and to facilitate the establishment and smooth functioning of such systems as part of a more sustainable economy (UNEP, 2001). So value does not seem to be only created anymore in the classical sense – for the company and its customers – but for more stakeholders; and value created for companies and customers is wider with PSS.

Christensen & Tan (2000) provide a challenge for PSS developers to consider that products can only be classified as innovative if they *"contain a difference (in relation to existing products) that induces appropriate, valuable and desirable effects on the company, consumer and society"*. According to McAloone & Andreasen (2002), the challenge of creating positive effects – appropriate, valuable and desirable – relates to logical, physical and psychological aspects that should be built-into products. The classification of stakeholders into three main groups – company, consumer and society – coupled together with the positive effects, makes this definition of innovation strong in a sustainability concept, as this forces a mindset of continuous product improvement in both a physical and a societal manner.

Some advantages for these stakeholders are presented below.

Table 5 – Advantages for stakeholders in PSS. (Source: UNEP (2001); Baines *et al.* (2007); Mont (2002)).

Benefits for customers	Benefits for companies	Benefits for governments /society
- More value obtained through more customization and higher quality. - Greater diversity of choices in the market. - Service component, being flexible, can deliver new functionality better to suit customer needs. - Removing administrative or monitoring tasks away from the customer and back to the manufacturer. - Lower costs and problems associated with buying, use, maintenance and eventual replacement of products. - Through PSSs, consumers may more easily learn about environmental features of products and how they can contribute to minimizing the environmental impacts of consumption.	- More opportunities for innovation and market development. - Increased operating efficiencies. - More and longer-term client relationships. - Improved corporate identity. - Better feedback on consumer needs. - The potential to use companies' technical knowledge to find ways to deliver same or better value-in-use while using less energy or materials is said to offer the potential to reduce cost.	- Fewer waste management concern for the domestic and manufacturing sector. - More sustainable economy based on high levels of service. - Increased employment. Through the increase in customization and in service activities, the loss of jobs in traditional manufacturing can be offset.

3.3.4 PSS and life-cycle thinking

Life-cycle seems to be the main focus for PSS along literature. Aurich *et al.* (2006) assert that product life-cycle management is the core issue for the design of PSS. Tan *et al.* (2010) stated that PSS approaches are sustainable innovation strategies in a total life-cycle perspective. The concept of life-cycle has traditionally been applied to physical products, so to manufacturing companies. It refers to the successive stages through which a product passes. Cavalieri & Pezzotta (2012) states that a successful offering and realisation of a PSS extends the involvement and responsibility of the provider throughout the entire life-cycle: from the design and realisation, to the usage and maintenance and the disposal.

In the field of designing, Kimura & Suzuki (1996) added that "*for sustainable product development, it is essential, to first design total product life-cycle in order to make reuse/recycling activities, more visible and controllable, and then to design products appropriate, to be embedded in the life cycle*". So the right order is to design the entire life-

cycle and then, once the needs throughout the life-cycle are clear, to design the product in detail, and never the other way round.

Mien & Feng (2005) present a life-cycle framework called 'Integrated Manufacturing and Product Service System (IMPSS)'. Figure 4 displays this framework. It identifies several stages of product life-cycle and services around these stages.
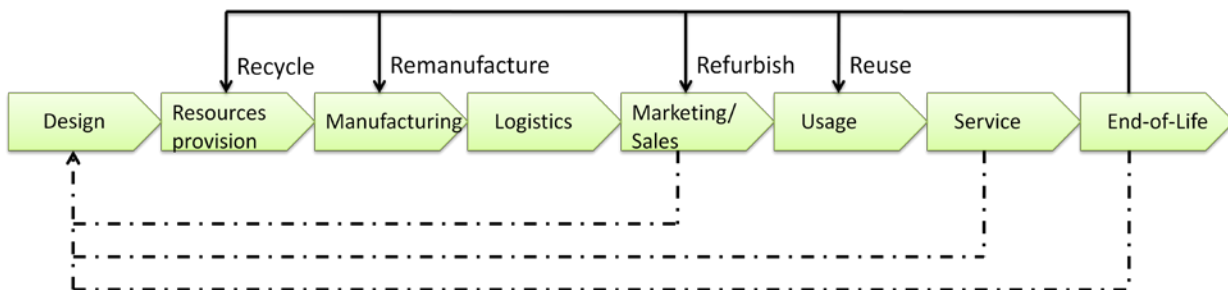
Figure 4 – IMPSS. Life-cycle frameworks. (Source: Mien & Feng, 2005).

Although Mien & Feng (2005) mention the term 'service' and it is a concept present within the model, this framework is oriented to products because the stages 'resources provision', 'manufacturing' or 'usage' for instance belong exclusively to physical products. Some ideas for service (exclusively) life-cycle framework have been suggested, for example by Ives & Mason (1990). They propose a framework of 'customer service life-cycle' for e-commerce which is shown as Fig 5. They divide a service life-cycle into four stages and each stage includes several service activities.
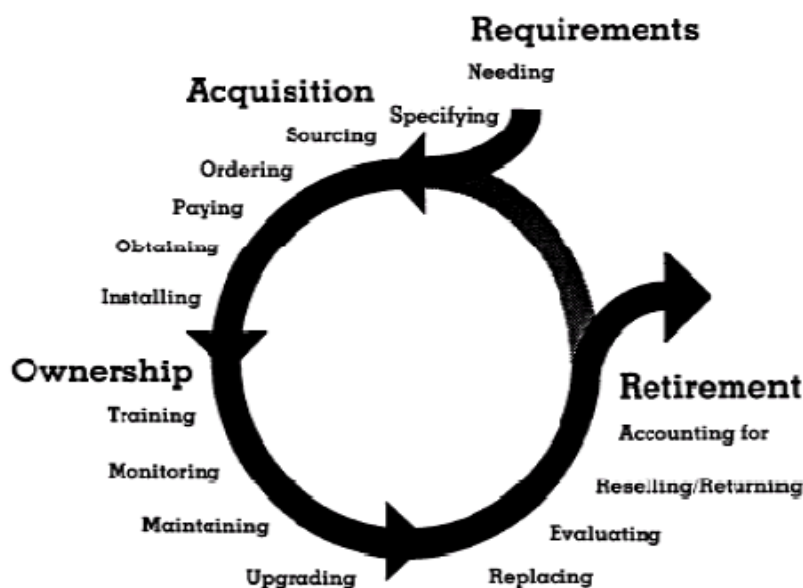
Figure 5 – Customer Service Life Cycle. (Source: Ives & Mason, 1990).

According to Lujing *et al.* (2010), most research on the modelling of PSS does not include the influence of customer behaviour on the life-cycle of a product, or the opinions of a service. On the other side, they add that other literature only considers the satisfaction of customer while falls short in studying the influence of customer behaviour to life-cycle model. Finally Lujing *et al.* (2010) presents a service life-cycle framework integrating product life-cycle. It has four stages: Service Requirement, Service Deployment, Service Processing and Service Retirement.

- *Service Requirement* is the beginning of all life-cycle. In this stage, PSS provider analyses customer requirement, product & service selling, and service customization. PSS is designed in this stage.
- *Service Deployment* includes service processes of product installation, paying, product delivering and training. In this stage, service and product are deployed and start to provide functions to customer.
- *Service Processing* includes the processes of quality of service: product maintenance, repairing, upgrading, service monitoring, service renew and retraining.
- *Service Retirement* is the end of service life-cycle, which includes service processes such as service evaluation and product take-back.
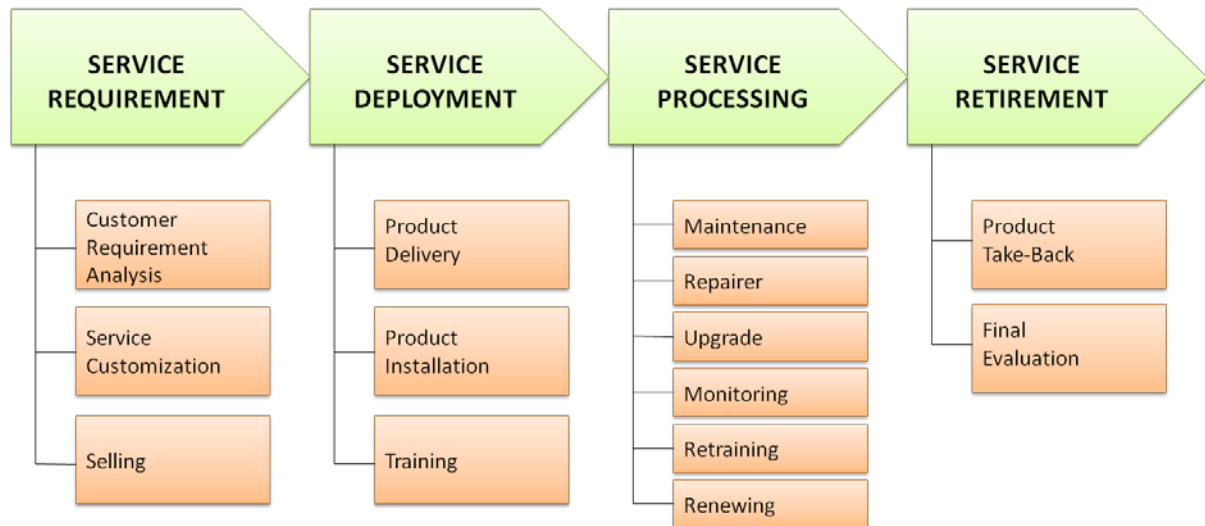
Figure 6 – Life-cycle model for Use-Oriented and Result-Oriented PSS. (Source: adapted from Lujing *et al.*, 2010).

3.3.5 Methodologies for PSS development

This section presents the literature review made on the topic of methodologies, methods and tools for the development of a PSS business model, though the literature review in this case will be somehow different. Here we will concentrate on the wide work made by Suspronet (2004): a brief summary of the methodologies they compiled. However, the specific tools are not explained here because from our point of view it does not make sense.

It will be in chapter 6, in which the tools chosen to build the toolkit for the PSS business model are presented, that every single tool will be explained. Some tools chosen there are taken from the methodology compiled by Suspronet and many others are from other authors.

To start with, it is worth stressing the difference between a *methodology* and a *method*. According to Morelli (2006), a methodology defines an operative paradigm, i.e. a ''toolbox'', including several different methods and tools, which can be used to solve determined logical or operational problems. PSSs represent a very wide area of intervention for a designer. The definition of a standard set of methods and tools to use to design PSSs is therefore impossible. However, designers should consider creating their own toolbox including methods and tools to be used in different contexts and for different PSS.

Next, part of the work made by Suspronet is presented. Suspronet is a network on sustainable Product-Service Systems Development funded by the European Community under the 'Competitive and Sustainable Growth' programme. In their final report (Suspronet, 2004), they compile the thirteen most important methodologies developed especially for PSS design. They chose these ones because they seemed interesting and promising for the combination of product and service system design and the inclusion of sustainability. The methodologies are:

- MEPSS (Methodology development and Evaluation of PSS)
- ProSecCo methodology (Product-Service Co-Design)
- HiCS (Highly Customerised Solutions)
- Austrian 'Eco-efficient PSS' project
- DES methodology (Design of Eco-efficient Services)
- INNOPSE innovation studio methodology
- BISS methodology (Business Models for Inherently Sustainable Systems)
- The Kathalys method for sustainable product-service innovation
- TNO/ PriceWaterhouseCoopers (PWC) PSS Innovation Scan for Industry
- The Innovation PSS workbook by James *et al.*

- Sustainable Homeservices
- Sustainable Product and Service Development (SPSD) approach for industry
- PSS methodology – Aalborg University

Eight out of 13 methodologies are specifically aimed at PSS development: MEPSS, Ecoefficient PSS, DES methodology, Kathalys method, PSS Innovation Scan for Industry, PSS Innovation handbook, Sustainable Homeservices and PSS methodology of Aalborg University. The other five are focused on innovation development in general and they do not exclusively direct towards PSS but they can also be used to develop products, services or partnerships. These ones are: ProSecCo, HiCS, INNOPSE, BISS methodology and Sustainable Product and Service Development (SPSD) - (Suspronet, 2004).

Five methodologies concentrate on specific process phases of the development process:

- INNOPSE concentrates on idea development process,
- The PSS Innovation Scan for Industry prepares the development team for a management presentation,
- The PSS Innovation handbook is developed to enhance the idea generation and selection phase,
- Sustainable Homeservices is focused on locating opportunities and defining the roles of actors in the system,
- The PSS methodology (Aalborg University) is focused on idea development and on representation of the developed PSS.

The other eight cover the complete development process until the market launch: MEPSS, ProSecCo, HiCS, Eco-efficient PSS, DES methodology, BISS methodology, Kathalys method, Sustainable Product and Service Development (SPSD). So, the methodologies that focus on sustainability (covering economical, environmental and social issues), on PSS development only, and cover the complete development process are MEPSS, Eco-efficient PSS and the DES methodology (the latter with little attention to social aspects).

All methods see SMEs as their primary target group, though most of them can also be used by larger companies or organizations. All methodologies rely on some kind of external support, varying from a facilitator of workshops to a full time external consultant. This facilitation by a highly experienced and somewhat neutral person or actor is seen as extremely important in the PSS design process and in PSS projects because the multi-actor development needs stringent facilitation. (Suspronet, 2004).

In the stated methodologies tools generally were taken from normal innovation or business development methodologies, but amended with specific PSS content. However, some of the research projects to design PSS methodologies created their own PSS design and assessment tools (e.g. HiCS and MEPSS project).

Annex I contains a summary table of the methods and tools compiled by Suspronet to develop a business model, highlighting those that are specific for PSS.

3.4   BUSINESS MODEL

3.4.1   Business model concept

Several authors have made in the last years a review of publications on the business model concept. Examples of these reviews are Morris *et al.* (2005), Osterwalder *et al.* (2005), Richardson (2008), Al-Debei & Avison (2010), Teece (2010), Bask *et al.* (2010), Zott *et al.* (2011) or George & Bock (2011).

In the attempt to give response to the requirements of more and more demanding customers, companies find themselves in constant changing. It is in this context that the concept of business model gains importance. As an example, its popularity and importance have risen from having 107.000 references in May 2002 in Google, to more than 602 million in June 2006 (Palacios Preciado & Duque Oliva, 2011).

According to Palacios Preciado & Duque Oliva (2011), many authors agree that the success of a particular business venture depends on a good business model; nevertheless, the definition of a business model remains vague. A lot of the fuzziness and confusion about business models stems from the fact that when different authors write about business models they do not necessarily mean the same thing (Linder & Cantrell, 2000). In the literature, the expression stands for various things, such as parts of a business model (e.g. auction model), types of business models (e.g. direct-to-customer model), concrete real world instances of business models (e.g. the Dell model) or concepts (elements and relationships of a model). (Osterwalder *et al.*, 2005). There is not a widely accepted definition and the term is used wrongly and randomly (Palacios Preciado & Duque Oliva, 2011).

In Zott *et al.* (2011) research on BM definition they state that in a general level the BM has been referred to as a *statement*, a *description*, a *representation*, an *architecture*, a *conceptual tool* or *model*, a *structural template*, a *method*, a *framework*, a *pattern* and a *set*. They also state that surprisingly the BM is often studied without an explicit definition of the concept. 37% of the publications they reviewed do not define the concept at all, taking its meaning more or less for granted. 44% explicitly define or conceptualize the BM, for example, by enumerating its main components. The remaining publications (19%) referred to the work of other scholars in defining the concept. Moreover, they found that existing definitions only partially overlapped, giving rise to a multitude of possible interpretations.

According to Magretta (2002) an appropriate business model must provide answer to Peter Drucker's (1954) age-old questions: 'Who is the customer? What does the customer value? How do we make money in this business? And what is the underlying economic logic that

explains how we can deliver value to customers at an appropriate cost?' Implicitly a business model is about how an organization earns money by addressing two fundamental issues – how it identifies and creates value for customers, and how it captures some of this value as its profit in the process (Casadesus & Ricart, 2010).

The lack of definitional clarity of BM represents a potential source of confusion, promoting dispersion rather than convergence of perspectives and obstructing cumulative research progress on business models (Zott *et al.*, 2011). Table 6 summarizes some of the most prevalent definitions suggested for Business Model.

Table 6 – Suggested definitions for Business Model.

Author (year)	Definition
Timmers (1998)	The BM is an architecture of the product, service and information flows, including a description of the various business actors and their roles; a description of the potential benefits for the various business actors; a description of the sources of revenues.
Linder & Cantrell (2000)	The organisation's core logic for creating value. The business model for a company aimed at benefits explains how the company makes money.
Chesbrough & Rosenbloom (2002)	The BM is the heuristic logic that connects technical potential with the realization of economic value.
Magretta (2002)	Business models are stories that explain how enterprises work. A good business model answers Peter Drucker's age old questions: Who is the customer? And what does the customer value? It also answers the fundamental questions every manager must ask: How do we make money in this business? What is the underlying economic logic that explains how we can deliver value to customers at an appropriate cost?
Rajala & Westerlund (2005)	The way to create value for customers and the way market's opportunities are turned into benefits by the company; through actor's groups, activities and collaborations.
Morris *et al.* (2005)	A business model is a concise representation of how an interrelated set of decision variables in the areas of venture strategy, architecture, and economics are addressed to create sustainable competitive advantage in defined markets.
Andersson *et al.* (2006)	BM are created with the purpose to clarify who are the business actors which meet themselves in a business case, and how their explicit relationships are. Relationships in a BM are formulated in terms of values exchanged between actors.
Baden-Fuller *et al.* (2008)	The BM is the logics of company, the way it creates and captures value for its stakeholders.
Johnson *et al.* (2008)	Business models consist of four interlocking elements, that, taken together, create and deliver value. These are customer value proposition, profit formula, key resources, and key processes.
Amit & Zott (2001); Zott & Amit (2009)	The business model depicts the content, structure, and governance of transactions designed so as to create value through the exploitation of business opportunities (2001). Based on the fact that transactions connect activities, the authors further evolved this definition to conceptualize a firm's business model as a system of interdependent activities that transcends the focal firm and spans its boundaries (2010).
Casadesus-Masanell & Ricart (2010)	A business model is . . . a reflection of the firm's realized strategy.
Teece (2010)	A business model articulates the logic, the data and other evidence that support a value proposition for the customer, and a viable structure of revenues and costs for the enterprise delivering that value.
Wikström *et al.* (2010)	The BM is used to describe or to design the activities that the organization needs or searches, to create value for costumers and other interested parts in the environment.
George & Bock (2011)	Design of the organizational structure, representing a comercial opportunity.

Some scholars surmise that the emergence of the business model concept, and the extensive use of the concept since the mid-1990s, may have been driven by the advent of the Internet (e.g. Amit & Zott, 2001), rapid growth in emerging markets and interest in "bottom-of-the-pyramid" issues (Prahalad & Hart, 2002; Seelos & Mair, 2007; Thompson & MacMillan, 2010), and the expanding industries and organizations dependent on post-industrial technologies (Perkmann & Spicer, 2010).

It is important to note that business models are perishable (Govindarajan & Trimble, 2011), so innovation is a critical factor for success in the current complex and changing environment. The survival of a firm depends on its ability to adapt to the changing context (Giesen *et al.*, 2010; Morris, 2009). Business models, new and innovative, can be successful regardless of firm's age, industry and location (Giesen *et al.*, 2010). The present large interest in business model innovation could be explained by the current rhythm of change of the world, inter-industrial competition, and the offer of better experiences for consumers (McGrath, 2011).

Casadesus & Ricart (2010) state the 'parts' business models are made of. They affirm that they are composed of two different sets of elements:

- The concrete *choices* made by management about how the organization must operate. We distinguish three types of choices.
    - Policy choices: refers to courses of action that the firm adopts for all aspects of its operation – for instance, opposing the emergence of unions; locating plants in rural areas; encouraging employees to fly tourist class, providing high-powered monetary incentives, or airlines using secondary airports as a way to cut their costs.
    - Asset choices: refer to decision about tangible resources, such as manufacturing facilities, a satellite system for communicating between offices, or an airline's use of a particular aircraft model.
    - Governance choices: refer to the structure of contractual arrangements that confer decision rights over policies or assets. For example, a given business model may contain (as a choice) the use of certain assets such as a fleet of trucks, which leads onto a governance choice for the firm as to whether it should own the fleet or lease it from a third party. Transaction cost economics suggests that seemingly slight differences in the governance of policies and assets can have dramatic effects on value creation and/or value capture.

- The *consequences* of these choices. Every choice has some consequences: for example pricing policies (choices) have obvious implications regarding sales volumes, which in turn, affect the economies of scale and bargaining power enjoyed by the company.

About BM with a service-approach
Although it is starting to gain importance, at this point it does not seem to be much research done on BM including sustainability or service approaches. The construction of a BM

framework for service firms is still in its first stages. However, Halme *et al.* (2007) give a framework proposal consisting of four questions in order to validate the viability of a service: (i) Which benefits can customers obtain from the service – comparing to other forms for satisfying the necessity? (ii)Which is the competitive advantage of the service? (iii)Which are the capacities of the service provider? (iv) How is the service financed?

Recommendations when developing a BM

Casadesus-Masanell & Ricart (2010) gave three recommendations on how companies can redesign their business models. Firstly, identify and boost virtuous cycles in their business model that will enable the organization to create and capture value in anticipation to the changes. Secondly, identify and correct vicious circles: the two main types are the vicious circle generated by weaknesses in the business model, and those who might become virtuous if accompanied of adequate complementary options. Finally, it must be noted that business models operate in interaction with other businesses. That can be handled in three ways: (i) reshaping the business model in order to add value to "open spaces", where there is little negative interaction with other industry actors, (ii) creating positive interactions, complementary where possible and reducing negative ones, or (iii) neutralizing them through tactical decisions.

3.4.2   Business model vs. Tactics and Strategy

According to Casadesus & Ricart (2010), the reason why there is not agreement among the academic community on which features should have business models is partly because of a lack of a clear distinction between the notions of *strategy, business models* and *tactics.* Briefly, the three definitions given by Casadesus & Ricart (2010):

- *Business Model* refers to the logic of the firm, the way it operates and how it creates value for its stakeholders.
- *Strategy* refers to the choice of business model through which the firm will compete in the marketplace.
- *Tactics* refers to the residual choices open to a firm by virtue of the business model it chooses to employ.

An approximation to the BM concept has been given in the previous section, so here the comparison to strategy and tactics is presented.

3.4.2.1 *Tactics*

Tactics are the residual choices open to a firm by virtue of the business model that it employs. Tactics are important, as they play a crucial role in determining how much value is created and captured by companies (Casadesus & Ricart, 2010). Different business models give rise to different tactics available for competition and/or cooperation. But there is more to tactics than this – in reality a firm's tactical choices also affect the value creation and value capture of other companies with which it interacts, either in cooperation or in competition. Feedback to the rest of the system is determined not only by the focal company's choices, but by the choices of the other companies as well. In short, the BM employed by a company determines the tactics available to the company to compete against, or to cooperate with, other companies in the marketplace (Casadesus & Ricart, 2010). Therefore, BM and tactics are intimately related.

Below two examples given by Casadesus & Ricart (2010) are useful to understand this relationship between BM and tactics.

1- Consider the example of a discount retailer competing against local 'mom-and-pop' store, with both engaging in a tactical pricing battle to win customers. The discount retailer's (lower) prices affect value capture for both the discounter and the mom-and-pop, and vice versa. While both firms use prices in their tactical interaction, the discount retailer brings superior weapons to the fight because of its business model - specifically, the range of prices it can profitably set is much broader than that of a competitor laden with a high-cost operating model. The battle is over before the combatants even engage and it is won at the business model level.

2- Now consider Metro, the world's largest newspaper (in terms of circulation), published in more than 100 cities in 18 countries. Being ad-sponsored, it is free to readers, and so competes with local newspapers sold at positive prices. In each city, Metro can make choices about its advertising rates, as well as the number of pages in each edition, the balance between news and opinion pieces, and so on: all of these choices are part of Metro's tactics. But Metro's ad-sponsored business model dictates it must be sold at zero price and so precludes Metro from using 'selling price' as a variable that can be changed depending on external factors. Therefore, 'price of the newspaper' is not part of Metro's set of tactics.

It is obvious that advertising rates displayed in Metro, end up affecting the readership and advertising revenues. Including more and more ads risks readers become increasingly irritated and less willing to read the newspaper. Likewise, if the

advertising rate increases, fewer advertisers will want to advertise, which will affect Metro's revenues, profits and value capture.

3.4.2.2 Strategy

Strategy is often defined as a contingent plan of action designed to achieve a particular goal (Casadesus & Ricart, 2010). Strategy is a high-order choice that has profound implications on competitive outcomes. While the resulting (created) activity system is a reflection of the firm's strategy; strategy proper is not the activity system – that is the business model – but the creation of that system (Porter, 1996).

Strategy is a firm's contingent plan as to the business model it will use. Little is gained from separating the concepts when strategy maps one-to-one onto business model (Casadesus & Ricart, 2010). The substantive difference arises when the company's contingent strategy calls for business model modifications.

3.4.3 Examples of business models

The goal of this section is to illustrate what a generic business model can look like. Some types of business models recurrent in literature for their success during the last years are presented briefly, highlighting their most important features.

Long tail business models

It is based on the fact that in certain businesses exist key finite resources crucial for their activity which force companies/stores to sell only those products that are expected to obtain best sales. It is called "long tail" due to the shape of the distribution graphic of the sales, where very few references accumulate most of the sales (bestsellers), and all the other references are sold much more occasionally (the tail).

A typical example of finite resource is the exposition space and the storage room in a store. But what happens when the cost of this finite resource drops dramatically? The answer is that it is also possible to make profit from selling lots of units of large number of references that are sold only occasionally. To achieve that it is necessary a very low cost of the finite resource and an effective system of recommendation to drive customers through the tail, in order to generate sales of those references with a lower demand.

A relevant example of a long tail based business model is Amazon and its electronic books. On one hand, a large amount of books are only stored digitally, and when a client orders a

copy it is printed on demand. A great effort is also being made to boost e-books. On the other hand, Amazon's recommendation technologies are brilliant: for a client who has already placed some orders, their recommendations are right in all likelihood.

'Bait & Hook' or 'Razor and Blade'

This type of business model refers to a pattern characterized by an attractive, inexpensive, or free initial offer that encourages continuing future purchases of related products or services. This pattern is also known as the 'loss leader' model because the initial offer can be even money-losing, with the intention of generating profits from subsequent purchases.

This pattern is popular in the business world and has been applied in many sectors. The mobile telecommunications industry provides a good illustration of "Bait & Hook" with a free offer. Operators initially lose money by giving away mobile phones for free, but they easily cover the loss through subsequent monthly service fees. The key to this model is the close link between the inexpensive or free initial product and the follow-up item – usually disposable – on which the company earns a high margin. Controlling the "lock-in" is crucial to this pattern's success. Through blocking patents, Gillette ensured that competitors couldn't offer cheaper blades for the Gillette razor handles.

Inkjet printers sector is another clear example. Manufacturers such as HP, Epson, and Canon typically sell printers at very low prices, but they generate healthy margins on subsequent sales of ink cartridges.

Multi-sided platform

Multi-sided platforms bring together two or more distinct but interdependent groups of customers. Such platforms are of value to one group of customers only if the other groups of customers are also present. The platform creates value by facilitating interactions between the different groups. The key is that the platform must attract and serve all groups simultaneously in order to create value. The platform's value for a particular user group depends substantially on the number of users on the platform's "other sides".

Many times a customer segment is subsidized. Although a platform operator incurs costs by serving all customer groups, it often decides to lure one segment to the platform with an inexpensive or free value proposition in order to subsequently attract users of the platform's

"other side". One difficulty multi-sided platform operators face is to understand which side to subsidize and how to price correctly to attract customers.

Some examples of that pattern are newspapers, Visa, Google, Facebook, Apple or Microsoft Windows. Credit cards link merchants with cardholders; computer operating systems link hardware manufacturers, application developers, and users; and newspapers link readers with advertisers.

Free

In the *Free* business model at least one substantial customer segment is able to continuously benefit from a free-of-charge offer. Any marketer or economist will confirm that the demand generated at a price of zero is many times higher than the demand generated at one cent or any other price point. Different patterns make the free offer possible. Actually some of these patterns are based on the business models described above but they are included here because of the particularity of the concept 'free'.

According to Osterwalder & Pigneur (2010), there are three main patterns that make free a viable business model option:

1) Free offer based on multi-sided platforms. Non-paying customers are financed by another part of the business model or by another customer segment.

2) Free basic services with optional premium services (the so-called "freemium" model).

3) The Bait & Hook model whereby a free initial offer lures costumers into additional purchases.

Metro (free newspaper – two-sided platform approach and advertising-based), Skype (free calling services via the Internet – *freemium* approach) or Spotify (free music on-line platform with ads – *freemium* approach) are a few examples of that pattern.

In the *freemium* model, a small base of customers paying for a premium service subsidizes a large base of non-paying customers. On the contrary, the insurance model is actually the opposite – it is the *freemium* model turned on its head. In the insurance model, a large base of customers pays small regular fees to protect themselves from unlikely but financially devastating events.

3.4.4 Elements of Business Model Frameworks

This section introduces the concept of 'framework' and mainly concentrates on the elements inside the BM frameworks. Subsections here contain the review of the most important topics related to framework's elements found in literature.

In the previous sections general concepts and ideas as 'PSS', 'sustainability' and 'business model' have been discussed. However, the term 'framework' has not been presented yet. Having a look at some definitions provided by standard dictionaries, a good approach to the idea can be obtained. Collins dictionary defines framework as *'a structural plan or basis of a project'* or *'a structure supporting or containing something'.* Oxford Dictionary defines it as *'an essential supporting structure of a building, vehicle, or object'.*

So if the scope of this work is to design a BM framework from these definitions it can be guessed that the aim is to fix the structure or basis for business models for PSS.

Business model frameworks are tools or lenses that help to recognize, build and develop the constructs of a viable business model (Horsti *et al.,* 2004). Moreover, frameworks are suitable for evaluating business models. (Horsti *et al.,* 2004).

Recent literature is gradually shifting away from business model definitions, and instead it focuses on decomposing business models into their "atomic" elements, also referred as "components", "attributes", or "pillars" of business models. Unfortunately, the differences in terms used propagate to create a multitude of approaches towards identifying business model components. (Pateli & Giaglis, 2003).

Formally, most of the BM frameworks proposed in the literature consist of these components, but there are other authors who present their frameworks as a group of questions to reflect on. Magretta (2002) is an example. The parts of his business model are defined by the following questions: (i) Whom does it serve? (ii) What is it going to offer? (iii) How is it going to be organized?

Both proposing questions and defining components are two different ways of presenting the model but equivalent anyway. The aim is to present the items, the basic topics one has to reflect on when designing a BM. The effect of both questions and components is the same: to make the user of the BM framework think about the topics introduced by them.

Table 7 presents a list of BM frameworks and their specific components. Part of it was compiled by Morris *et al.* (2005) and it has been completed adding most recent authors' work.

Table 7 – Elements of different business model frameworks. (Adapted from Morris *et al.,* 2005).

Author (year)	No. Of components	Specific components / Questions
Timmers (1998)	5	Architecture for product/service/information flows, business actors and their roles, potential benefits of the actors, sources of revenue, marketing strategy.
Donath (1999)	5	Understanding the customer, marketing tactics, corporate governance, intranet, and extranet capabilities.
Hamel (2000)	4	Core strategy, strategic resources, value network, customer interface.
Chesbrough & Rosenbaum (2000)	6	Value proposition, target markets, internal value chain structure, cost structure and profit model, value network, competitive strategy.
Gordijn *et al* (2000)	8	Actors, market segment, value offering, value activity, stakeholder network, value interfaces, value ports, value exchanges.
Dubosson-Torbay *et al* (2001)	4	Products and services, relationship with customers, infrastructure and network of partners, financial aspects.
Afuah & Tucci (2001)	8	Customer value, scope, price, revenue, connected activities, implementation, capabilities and sustainability (team up strategy).
Peterovic *et al* (2001)	7	Value model, resource model, production model, customer relations model, revenue model, capital model, market model.
Rayport & Jaworski (2001)	4	Value cluster, market space offering, resource system, financial model.
Amit and Zott (2001)	3	Transaction content, transaction structure, transaction governance.
Richardson (2008)	3	Value proposition, value creation and delivery system, value capture.
Osterwalder & Pigneur (2010)	9	Customer segments, value proposition, channels, customer relationships, revenue streams, key resources, key activities, key partnerships, cost structure
Wikström *et al* (2010)	6	Value proposition, Structure of the entity, Nature and mechanisms of growth, Distinction of the competition, Customers participation, Context and collaborative mechanisms.
Eyring *et al* (2011)	4	Customer Value Proposition (CVP), Profit formula, Key processes, Key resources.

The existing business model research has produced a plethora of lists of elements of business models. However, it is easy to detect a considerable overlap in many elements which appear in most of the lists (see Table 7). The nomenclature and the arrangement of the elements vary depending on the researcher's perspective. For instance, the value proposition-related element, in Table VI, appears with different names. Eyring *et al.* (2011)'s element is called "Customer Value Proposition", whereas the element of Wikström *et al.* (2010) is "Value Proposition". Taking into account that Eyring *et al.* do not add any more element related with customers, "Customer Value Proposition" includes (i) value proposition and (ii) customers, so it expresses that it is a customer-centered value proposition and there is no reason for separating these items.

Just to illustrate the idea, a well-known example within the literature is the canvas proposed by Osterwalder (2004). According to them a business model can best be described through nine basic building blocks, which cover the four main areas of a business: product, customer interface, infrastructure management, and financial aspects. These building blocks are presented in Table 8.

Table 8 – The nine business model building blocks and their description. (Source: Osterwalder, 2004).

Pillar	Building block of business model	Description
Product	Value proposition	A value proposition is an overall view of a company's bundle of products and services that are of value to the customer.
Customer interface	Target customer	The target customer is a segment of customers a company wants to offer value to.
	Distribution channel	A distribution channel is a means of getting in touch with the customer.
	Relationship	The relationship describes the kind of link a company establishes between itself and the customer.
Infrastucture management	Value configuration	The value configuration describes the arrangement of activities and resources that are necessary to create value for the customer.
	Capability	A capability is the ability to execute a repeatable pattern of actions that is necessary in order to create value for the customer.
	Partnership	A partnership is a voluntarily initated cooperative agreement between two or more companies in order to create value for the customer.
Financial aspects	Cost structure	The cost structure is the representation in money of all the means employed in the business model
	Revenue model	The revenue model describes the way a company makes money through a variety of revenue flows.

We are also going to point out here the framework proposed by Richardson (2008). It is organised around the concept of value and it is composed of three major elements. According to the author these elements reflect the logic of strategic thinking about value. Table 9 presents Richardson's framework.

Element	Description	Includes
Value proposition	What the firm will deliver to its customers, why they will be willing to pay for it, and the firm's basic approach to competitive advantage.	(i) The offering (ii) The target customer (iii) The basic strategy to win customers and gain competitive advantage.
Value creation and delivery system	How the firm will create and deliver the value to its customers and the source of its competitive advantage.	(i)Resources and capabilities (ii) Organization: the value chain, activity system, and business processes (iii) Position in the value network: links to suppliers, partners and costumers.
Value capture	How the firm generates revenue and profit.	(i) Revenue sources (ii) The economics of the business

3.4.4.1 About Value Proposition

In the interest of developing a coherent and internally consistent conceptual framework, according to Lambert (2008) the business model element that commands primacy must be identified, and *value proposition* is that element.

The value proposition is defined by Richardson (2008) as what the firm will deliver to its customers, the offering; why they will be willing to pay for it and the firm's basic approach to competitive advantage. It is the basic strategy to win customers and gain competitive advantage. According to Osterwalder & Pigneur (2010) the value proposition is the reason why customers turn to one company over another. It solves a customer problem or satisfies a customer need. Each value proposition consists of a selected bundle of products and/or services that caters to the requirements of a specific customer segment. In this sense, the value proposition is an aggregation, or bundle, of benefits that a company offers customers. Some value propositions may be innovative and represent a new or disruptive offer. Others may be similar to existing market offers, but with added features and attributes.

The primacy of the *value proposition* stems from the fact that all the other elements of a business model flow from this element, without which the entity would not exist, or at least, would have no reason to exist. Nothing else in the business model makes sense without

reference to the *value proposition*; Lambert (2008). Support for primacy of the *value proposition* is evident in the literature – see Table 7 and the recurrence of the element *value proposition* or similar (customer value proposition, value cluster, value model, value offering…).

3.4.4.2 About Value creation

Elements of the following non-exhausting list can contribute to customer value creation. Source: Osterwalder *et al.,* 2010.

- Innovation. Being the first to satisfy a customer need. Often this need was not even perceived because there was no similar offer.
- Performance. Improving product or service performance.
- Customization. Tailoring products and services to the specific needs of individual customers or customer segments. Here, it is as well worth mentioning 'confidentiality', some kind of an extreme customization. For example, instead of offering a cooking course in a conventional cooking school, offering it individually at the client's home, with his/her kitchen utensils and installations.
- "Getting the job done" or functional result. Offering a result regardless of the means or products used. (See p. 23 for more on 'Functional result').
- Design. A particular design can be a particularly important part of the value proposition in some industries.
- Brand/status. Customers may find value in the simple act of using or exhibiting a particular brand. A specific brand may implicitly mean something; the so-called brand power.
- Price. Offering similar value at a lower price is a common way to satisfy the needs of price-sensitive customers. Free price is a particular case (see p. 44 for further information about 'free').

Value proposition may be created not only by the company but for a group of companies working together in fulfilling a customer's need. Thus, the concept of value *co-creation* must be introduced. According to Romero & Molina (2011), co-creation can be understood as a cooperative process involving interactions between customers and organizations in all creative activities. The potential of value co-creation is achieved through developing and exploiting these interactions with the ultimate aim of co-designing and co-producing the next level of value for a product or a service, exceeding in this way customers' greatest expectations with an entire experience around their favourite products and services.

In this matter, value co-creation can be defined as: "*corporations processes for co-creating goods, services and experiences in close cooperation with experienced and creative consumers, tapping into their intellectual capital, and in exchange rewarding them for what actually gets co-produced, co-manufactured, co-developed, co-designed, co-serviced and/or co-processed*" (Trendwatching-Global Consumer Trends, Ideas, and Insight, 2006).

Value co-creation has shift the traditional idea of value creation, where customers were seen as "*destroying the value which organizations create for them*", while in alternative, the new value creation paradigm views customers "*actively co-creating and re-creating value with organizations*" (Ramirez, 1999). As mentioned by Prahalad & Ramaswamy (2004), in today's competitive landscape, organizations as producers of goods and services cannot exclusively create added value for customers. Increasingly, value propositions have to be jointly created by both corporations and consumers as co-producers.

Following this new value co-creation approach, organizations are trying to re-invent their strategies by participating in collaborative networks in order to maintain their competitive advantages through the emergence of new value creation practices (e.g. value co-creation, co-innovation/open-innovation) based on a *continuum of collaboration* together with their customer communities.

For this reason, organizations are increasingly starting to operate in collaborative networked environments seeking for complementarities that allow them to offer integral and personal experiences around their products and services for a specific customer at any specific time, location and context (Romero & Molina, 2011).

Furthermore, customers are coming together in online communities where they are publishing and sharing (e.g. blogging, podcasting) their experiences with products and services, and therefore evaluating the effectiveness of their producers, vendors and service providers. Customers are comparing each other's experiences, giving feedback to each other and as a result, customer communities are becoming an important influence in purchase decisions and brand loyalty (Romero & Molina, 2011). In this scenario, collaborative networks can enable the infrastructures for handling heterogeneity of experiences and recognizing customers' individuality across multiple *interactive channels* (points of interaction) (Romero & Molina, 2011).

Allee (2000) classifies value into three currencies. A value network generates economic value through complex dynamic exchanges between one or more companies, customers, partners and other stakeholders. These networks engage in more than just transactions around

goods, services, and revenue. The two other currencies are knowledge value and intangible value or benefits. Allee call them currencies because all three serve as a medium of exchange, which is the basic definition of currency. All three are important in a value network.

- **Goods, services and revenue (GSR)**. Exchanges for services or goods, including all the transactions involving contracts and invoices, return receipt of orders, request for proposals, confirmations, or payment. Knowledge products or services that generate revenue or are expected as part of service (such as reports or package inserts) are part of the flow of goods, services, and revenue.
- **Knowledge.** Exchanges of strategic information, planning knowledge, process knowledge, technical know-how, collaborative design, policy development, etc., which flow around and support the core product and service value chain.
- **Intangible benefits.** Exchanges of value and benefits that go beyond the actual service and that are not accounted for in traditional financial measures, such as a sense of community, customer loyalty, image enhancement, or co-branding opportunities.

Den Ouden (2011) adds that meaningful innovations aim to create a more holistic value, in which the value of the whole is perceived as more than the sum of its parts. This requires integrative thinking, as the seemingly conflicting needs of different stakeholders will need to be integrated into one overall value proposition. Meaningful innovations combine value at the four levels, which are: (i) user, (ii) organization, (iii) ecosystem, and (iv) society. Table 10 shows some examples of starting points for new value propositions, providing different types of value for each of the four levels.

Table 10 – Elements of meaningful innovations. (Source: Den Ouden, 2011).

Level	Value Proposition	
User	Experience	Offers a pleasurable experience for users, seducing them into changing their behaviour and keeping on using the product or service to contribute to an increased quality of life.
Organization	Doing well	Provides an opportunity for sustainable value to ensure the continuity of the organization.
Ecosystem	Doing good	Allows the creation of ecosystems that can adapt to inherent changes and dynamics over a longer period of time and keep providing value for all stakeholders.
Society	Transformation	Improves the quality of life for society as a whole and cares for people and planet.

3.4.4.3 About customers and channels

A company may separate its customers into different segments. According to Osterwalder & Pigneur (2010) customer groups represent separate segments if:

- Their needs require and justify a distinct offer.
- They are reached through different distribution channels.
- They require different types of relationships.
- They have substantially different profitability.
- They are willing to pay for different aspects of the offer.

There are different types of customer segments, for example: (i) mass market – no distinction of customer segments; everything focus on a large group of customers, as in consumer electronics sector –, (ii) niche market – specific and specialized groups –, or (iii) segmented groups – for instance according to their wealth.

A company generally creates value for specific target customer segments. In order to satisfy customers better, a company may group them into distinct segments with common needs, common behaviours, or other attributes. A business model may define one or several large or small customer segments. An organization must make a conscious decision about which segments to serve and which segments to ignore. Once this decision is made, a business model can be carefully designed around a strong understanding of specific customer needs or preferences (Osterwalder & Pigneur, 2010). Furthermore, once having the different groups classified, and with an accurate information about their preferences, the company can target other groups which were not their target customer at the beginning by adapting the value proposition.

Channels describe how a company communicates with and reaches its customer segments to deliver the value proposition. Communication, distribution, and sales channels comprise a company's interface with customers. Channels are customer touch points that play a crucial role in the customer experience. In PSS, where the relationship with customers is so important, finding the right mix of channels to satisfy customers is basic in bringing a value proposition to market. (Osterwalder & Pigneur, 2010).

Classic literature on the subject (e.g. Osterwalder & Pigneur, 2010) often suggests five phases for channels, where a channel can cover some or all of these phases: awareness, evaluation, purchase, delivery and after sales. However, this classification is too product-centred, because in a PSS context the after sales concept does not fit properly as in many

cases there is no difference between the first delivery of the service/product and the consecutives. Hence, the suitable phases of channels in PSS would be:

- Awareness. How is awareness raised about a company's PSS?
- Pre-evaluation. Where the customer compares his needs to the company's offer (e.g. limited software trial).
- Purchase. How the company allows customers to purchase a specific PSS?
- Delivery. How is the value proposition delivered to customers?
- Bidirectional communication. How can costumers give their opinion about the company's value proposition? How can companies set out their worries and questions to customers? Organizations need to be able to access and use information in order to reduce uncertainty and take actions to increase performance.

Regarding channels to communicate with customers and particularly the Internet phenomenon, according to Bask *et al*. (2010) the Internet not only provides companies with a new channel in which to meet their customers, but also platforms for cooperation between companies and customers in developing and testing new services, technologies, and products. In addition to conventional channels, companies are able to choose among several digital channels, facilitating different strategic positions for services. This multi-channel environment poses new challenges, but also offers new opportunities.

3.4.4.4 About collaborative networked organizations

According to Osterwalder & Pigneur (2010) four different types of partnerships can be distinguished:

- Strategic alliances between non-competitors.
- Coopetition: strategic partnerships between competitors. Coopetition is the addition of competition and cooperation.
- Joint ventures to develop new businesses.
- Buyer-supplier relationships to assure reliable supplies. In this category the relationship between company and customer is included.

Camarinha-Matos *et al.* (2009) state that participation in networks has nowadays become very important for any company that strives to achieve a differentiated competitive advantage, especially if the company is small or medium sized. They add that collaboration is a key issue to rapidly answer market demands in a manufacturing company, through sharing competencies and resources. Figure 7, by Camarinha-Matos *et al.* (2009) displays the

different levels of interaction between companies vs. their integration level. As we move along from networking to collaboration, we increase the amounts of common goal-oriented risk taking, commitment, and resources that participants must invest into the joint endeavour (Camarinha-Matos *et al.,* 2009).
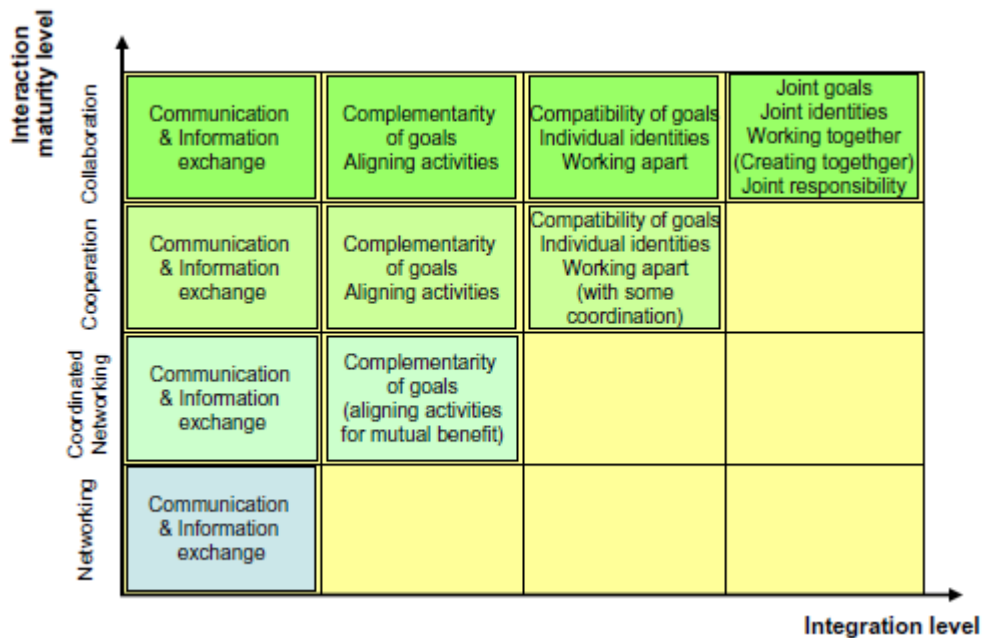
Figure 7 – Interaction maturity levels vs. integration level. (Source: Camarinha-Matos *et al.*, 2009).

Three particular options found in literature to form collaborative networks are presented and discussed next: supply-chain, value network and virtual factory.

Supply-chain

It is a product-centred concept. The network created amongst different companies producing, handling and/or distributing a specific product. Supply-chains include every company that comes into contact with a particular product. For example, the supply-chain for most products will encompass all the companies manufacturing parts for the product, assembling it, delivering it and selling it. Supply-chain management is a crucial process for many companies, and many companies strive to have the most optimized supply chain because it usually translates to lower costs for the company.

Designing the supply-chain concurrently with the product-service system is a supply-chain management as well as an environmental best practice.

A value network is a set of connections between organizations and/or individuals interacting with each other to benefit the entire group. A value network allows members to buy and sell products as well as share information. Each member relies on the others to foster growth and increase value. Value network members can consist of external members such as customers or internal members such as research and development teams. Weakness in one node can affect the entire network.

Reference: http://www.investopedia.com/terms/v/value-network.asp#axzz20zp065g4 (7/07/2012)

Virtual Factory

The core idea under the concept of the virtual factory is that enterprises become organized into a co-operative network. It is a novel way of organizing enterprises to work together to gain some of the benefits of being a large, multinational company, without many of the problems. They work together successfully because of highly organized management and communications systems. (Schuh, 1998).

According to Katzy & Schuh (1999) the virtual enterprise (or factory) is based on the ability to create temporary co-operations and to realize about the value of a short business opportunity that the partners cannot (or can, but only to lesser extent) capture on their own.

A network of companies which can quickly organise virtual factories to respond to the needs of customers can offer a much wider range of services and products than a considerable larger individual company. The number and range of companies in each virtual factory is specific to each order and individual companies in the network can be part of several different virtual factories at any one time. Marketing, order acquisition and some of the overall management is partially taken over by the network, so individual companies can concentrate on developing technical skills and keeping their overheads down.

In the EUREKA project MARKET97, in 1998, 27 companies were working together as partners. Individual companies within the network were gaining significant benefits from their involvement in the project. They had increased their markets and their customer base without the need to increase marketing costs and had been able to specialize and concentrate on their strengths (Katzy & Schuh, 1999).

The notion of a virtual company or factory relates to the cooperating resources component of this new characterization of the production system. As production and service

organization move to concentrate on their core competencies, cooperation has emerged as the method of choice instead of being viewed as a necessary evil. Vertical integration, which was often viewed as a method of gaining competitive advantage is being largely replaced with distributed cooperation (Preiss, 1995). Accordingly, various degrees of outsourcing are replacing vertical integration as companies opt to dislocate operations that are outside of their core competencies. The ultimate virtual company might be viewed as one with its operations outsourced entirely leaving coordination of the value chain as its sole operation. In any case, the key to the successful co-operation of companies within the network is good organizational management.

3.4.4.5 About the revenue model

Once the value proposition has been offered, capturing this value, in an economic sense, is as important as offering a strong value proposition. There are several ways to generate revenue streams. Next the classification given by Osterwalder & Pigneur (2010) is presented.

- Asset sale. The most widely understood revenue stream derives from selling ownership rights of a product, or selling a service. It is particularly used with PSS with high product part (Product-Oriented PSS). A product is sold and with the price some services are included, or these services are paid separately, at the moment of service.
- Usage fee. The more the product-service is used, the more the customer pays.
- Subscription fees. This revenue stream is generated by selling continuous access to a service. Gyms usually work with subscription fees.
- Lending/Renting/Leasing. This revenue stream is created by temporarily granting someone the exclusive right to use a particular asset for a fixed period in return for a fee.
- Licensing. This revenue stream is generated by giving customers permission to use protected intellectual property in exchange for licensing fees.
- Brokerage fees. It derives from intermediation services performed on behalf of two or more parties. Credit card providers earn revenues by taking a percentage of the value of each sales transaction.
- Advertising. The revenue stream derives from fees for advertising a product, service or brand.

Some research has been done on costing models with a sustainability approach. Some authors have made research about environmental accounting (e.g. Burrit *et al.,* 2009; Curkovic *et al.*, 2007), life-cycle costing (e.g. Rivero *et al.,* 2007) and eco-efficiency (e.g.

Burritt *et al.*, 2006); but not much research has been done about social sustainability costing. One particularly interesting method on environmental costing is the one proposed by Cagno *et al.* (2012), which enables a proper analysis of the flows of products, by-products and wastes produced by a plant. The proposed method origins from a general activity-based environmental costing and considers as cost objects not only the expected products, but also by-products and wastes.

Costs should be minimized in every business model. But low cost structures are more important to some business models than to others. Therefore it can be useful to distinguish between two broad classes of business model cost structures (Osterwalder *et al.,* 2010):

- Cost driven. They focus on minimizing costs wherever possible.
- Value driven. They focus on value creation and they are less concerned about the cost implications. Premium value propositions (e.g. a luxury hotel with all its exclusive services) and business models with high degree of customization fall into this category.

3.5   IMPORTANT FINDINGS

3.5.4   General findings

In this section the most important findings from the previous literature review are presented. They are summarized here in order to point out the essential issues as they are the compilation of the key points throughout the literature review. These findings are taken as basis for the development of the framework, so their importance is essential.

- Sustainability for manufacturing means that a broader scope of stakeholders has to be considered and that the three pillars of sustainability (environmental, social and economical) have to be taken into account.
- Taking into account the outstanding tendency towards sustainability in the literature (and bearing in mind that in some cases fulfilling certain sustainability-related standards has become compulsory) in this work sustainability plays a central role.
- A business ecosystem approach is then necessary when defining business models, in order to consider more stakeholders.
- PSS is a BM type that is closely connected to sustainability in literature, thanks to several advantages regarding the three pillars.
- A life-cycle approach is needed when talking about PSS. Product life-cycle management is the core issue for the design of PSS.
- A BM is '*the logic of the firm, the way it operates and how it creates value for its stakeholders*'. In our opinion the common thread across all of the approximations to the notion of business model is well captured by this definition by Baden-Fuller *et al.* (2008). We adopt their definition as the starting point for our argument.
- Value is essential in business models, so the business model has to be value-centred. The BMF proposal made by Richardson (2008) is considered very important because it is focused on value, and it is a source of inspiration in this work.
- There are several BMF in the literature, and it was observed that some elements are very often repeated, so these elements would be taken into consideration for the rest of the work.
- Nine out of the fourteen BM frameworks presented in Table 7 (Section 3.4.4) include the 'value proposition' element or similar (in some of them, this element also includes customers for example). If there is no offering there is no business. So it is clear that value proposition (VP) is essential in business models and it would be taken into consideration.

- The relationship between the company and a customer plays a key role if the PSSs are to be designed and run effectively.
- Channels are used for a wide range of purposes. A clear distinction would be made between delivery channels (of a physical product) and communication channels (awareness, evaluation, customers' requests…).

3.5.5 Findings on types of value

The definition of value creation discussed in the literature review (see 3.4.4.2) could be called 'the classic approach' focusing in the value created for costumers. But apart from value for customers other types of value can be created: "sustainable value" in a generic term. This sustainable value can be defined as: creating value for the entire ecosystem (or the company's stakeholders) and creating it in the three pillars of sustainability. These two blocks forming the sustainable value are developed next.

1. An important objective of PSS is to seek the value creation for all the stakeholders, or at least for several stakeholders and not only for customers and the company. It is essential to bear in mind that a company develops its activity within an ecosystem. Working with certain partnerships or in a certain value network or supply chain is a way to create value for other parts.

2. Bearing in mind the three pillars of sustainability it can be created environmental value, social value and economic value.

   - Environmental value: being *greener* in any of the possible senses of environmental sustainability is an added value nowadays.
   - Social value: generating value in the society, as social policy compliance or taking into account consumer health and safety for instance. Having a positive impact in the community of the area where a company is placed is another way to create social value.
   - Economic value: apart from being able to maintain the company's activity in the long term, just to mention an example, having an indirect economic impact in other companies as a result of the economic activity of a company is an extremely positive effect that should be taken into account.

The most interesting point of all that is the positive return that it may get the company by creating all these different types of value even in those cases that the effort to create value does not seem to have a clear benefit. For instance, positioning a company in a green

position, putting into practice specific environmental standards (more than the compulsory ones), may enhance the brand value, or the reputation, and it may results in an increase in the number of customers and economic benefits.

4. METHODOLOGY

In this chapter the methodology or process used to build the Business Model Framework for Product-Service System is explained. It is also presented the methodology to develop the toolkit for developing a PSS business model. The main steps have been:

1- An extensive literature review on the state of the art of related concepts: sustainability and its pillars and dimensions, business ecosystem, PSS, business models, business model frameworks, services, value and value co-creation… It has been presented in section 3 of this work. Most of the information has been found using the database of research literature "Scopus", and with other academic articles from the Internet (Academic Google) from scientific-technical publications.

2- Merging all the topics of the literature review in order to design the suitable elements for the Business Model Framework for PSS. Here the following sub-steps have been applied:

   - Trying to include all the relevant aspects of PSSs' characteristics in the framework. Obviously, the characteristics included in the BM framework are those which apply to business model level – at least from our point of view -, and not to strategy or tactics.

   - Checking the frequency in which a concept appears in the frameworks revised in the literature review. If a concept is repeated in a high percentage it probably means it is essential for business models.

   - Defining the building elements and then, inside each element, a list of sub-elements are added to concretize the element's content and to guide the designer of every single firm through all the important points to think about.

   - Choosing an appropriate name or label for each element, sufficiently representative of the element's content.

3- In order to build the toolkit to run a PSS design project several tools found in the literature have been reviewed. First of all, a classification of all the tools has been done with several indicators, and then and aggregated criteria have been applied to choose the suitable tools for the toolkit. A presentation of each of the studied tools is added then.

5. PROPOSAL OF A BUSINESS MODEL FRAMEWORK FOR PSS

Before presenting the Business Model Framework, considering that (i) any business model is developed within a business ecosystem and (ii) the specific importance of the ecosystem approach in PSS, a proposal for a business ecosystem map is made taking as reference the previous literature review. Next, the proposal of a Business Model Framework (BMF) for PSS is presented, identifying the different elements within the framework.

5.1   BUSINESS ECOSYSTEM MAP

Drawing the precise boundaries of an ecosystem is complicated and rather impossible so companies should try to systematically identify the organizations with which their future is most closely intertwined and determine the dependencies that are most critical to the company. What is going to be proposed here is a business ecosystem map. Adding then the links and relationships between the organizations themselves and with our company, the ecosystem would be completely defined. However, defining these relationships from a theoretical point of view is impossible and would be every single company to define them precisely. So the proposal here is the identification of the different stakeholder groups to be taken into consideration for defining the company's business ecosystem map.

We could define in a general way that the whole group of stakeholders forms the ecosystem map. Probably the definition is concise and includes all the possible casuistry. However, it is not very explicit and defining a few groups of typical stakeholders may be more graphic and useful for companies. The following groups are the chosen ones, according to the previous literature review.

- Customers
- Employees
- Government & Public Stakeholders
- Local communities & Society
- Organizations & NGOs (Non-Governmental Organization)
- Shareholders
- Markets
- Suppliers, Competition & Other Stakeholders

The main element is the customer; without customers companies cannot survive, so customers are the first element. The order presented for the other ones is at random, in general terms there is not a more important group than another. Their level of importance will depend on each company's particular context.

Once defined these eight groups forming the business ecosystem map, the organization pattern based on complex systems is taken (see section 3.2 in the literature review). The complexity aspects in business ecosystems are:

- Self-organization
- Emergence
- Co-evolution
- Adaptation

Furthermore in a business ecosystem there is both competition and cooperation simultaneously, so these characteristics are also included in the proposal for their relevance. In fact, in general terms relationships and links between organizations are ruled by competition and cooperation.

The presented business ecosystem map is generic for any kind of company, having a PSS approach or not. In our opinion a general business ecosystem applies to any type of company. It will be then that every single company will take this proposal and will choose its stakeholders from the presented groups.

The only particular point between PSS and business ecosystem is that in PSS' philosophy this ecosystem is essential because it is aimed that value is created taking into account all stakeholders, and not only the company.

Figure 8 displays the business ecosystem map proposal, incorporating all the mentioned elements.
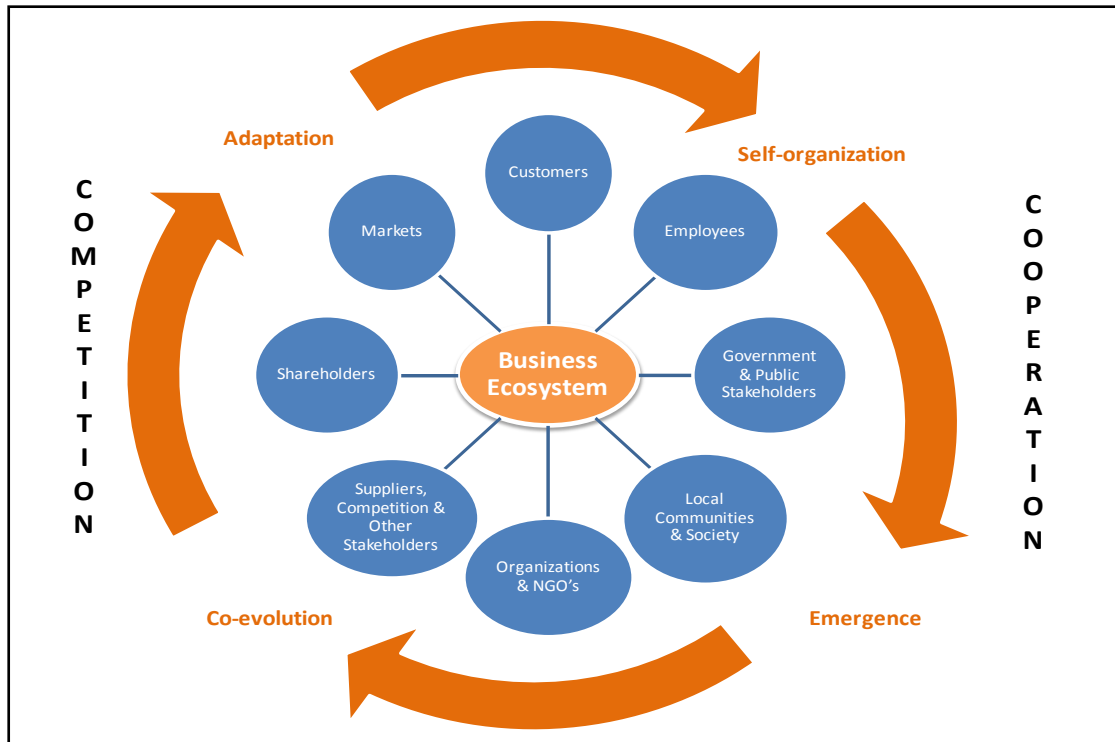
Figure 8 – Business Ecosystem map proposal.

5.2   PROPOSAL OF THE BUSINESS MODEL FRAMEWORK FOR PSS

Next, the Business Model Framework (BMF) for PSS is presented. It is composed of 5 elements. To the ideas of business models and business model frameworks, have been incorporated the essential ideas of PSS, always with a sustainable approach. Below, each component of the framework is discussed and the specific sub-elements are mentioned in order to show how the framework can be used to think strategically about the way a firm does business.

The 5 elements of the Business Model Framework for PSS are:

- LCVP (Life-Cycle Value Proposition)

- Customer Behaviour

- Value Configuration

- Value Capturing Structure

- Sustainability

Not all the elements have the same structural features. To understand the idea a distinction will be made between vertical elements and background. Sustainability, including all its three items (environmental, social and economic) is the background element. Background in the sense it is like a canvas, the arena or a sheet from where the model can be built. The broad concept of sustainability affects or should affect every single part of the business; so to make a graphic parallelism, sustainability is in the foundations and the 4 other elements are the pillars; designed with a sustainable approach.

Customers are the basic pillar of the BM, so it is a customer-centred BMF. Then, as it has already been explained, the life-cycle concept is essential in PSS, and value proposition is built with a life-cycle approach. The other two vertical elements – Value Configuration and Value Capturing Structure – try to explain how the Life-Cycle Value Proposition is achieved and how profit is taken, so the means making the business possible; everything with a sustainable approach. Figure 9 displays graphically the BMF for PSS.

Each element has its corresponding sub-elements which define and concretize the element's content. Figure 10 summarizes the whole BMF including the elements, the sub-elements and a brief definition of each one.

Figure 9 – Business Model Framework for PSS.

SUSTAINABILITY

A sustainable approach is basic in PSS regarding the three pillars (economic, environmental and social), and affects the rest of the elements, so the whole BM.

LCVP

Value or offering for each of the stakeholders, with a life-cycle approach.

CUSTOMER BEHAVIOUR

CUSTOMER PREFERENCES

Customer's desires, the need to be satisfied. Preferences are in constant evolution.

USAGE PATTERN

Customer's manner of using the product-service.

INFORMATION FLOW CHANNELS

The means to raise awareness about the offering and to allow communication between company and customer.

VALUE CONFIGURATION

RESOURCES

The assets (physical, financial, intellectual or human) to make a BM work.

ACTIVITIES

The tasks a company does to make a BM work using the resources.

PARTNERSHIPS

The network of suppliers and partners that make the BM work.

DISTRIBUTION & DELIVERY CHANNELS

The means that allow the delivery of the value proposition to customers.

VALUE CAPTURING STRUCTURE

ECONOMIC VALUE CAPTURE

The way earnings are achieved. It includes the revenue model and the costing model.

NON-ECONOMIC VALUE CAPTURE

Other types of value that at least directly do not result in cash.
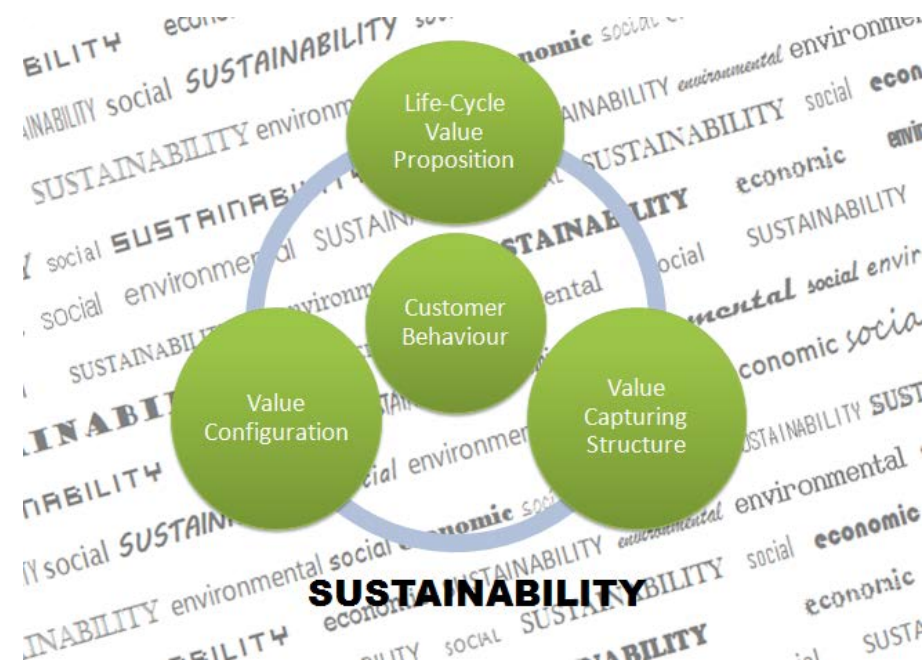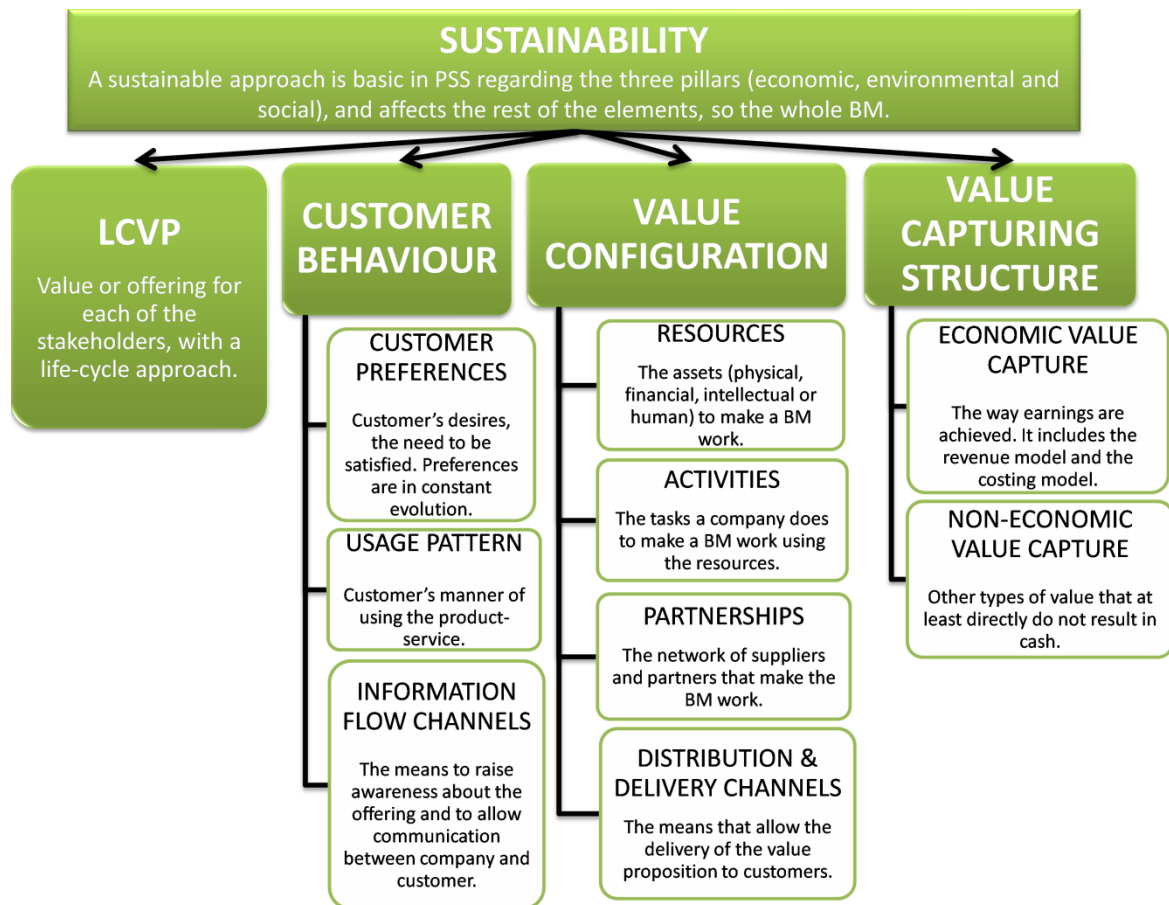
Figure 10 – Elements and sub-elements of the BMF for PSS.

Following sub-sections deal with the four vertical elements of the BMF for PSS presented, and the relevant aspects are pointed-out. Sustainability, the transversal element, is not presented alone because this is the element all the rest of the business model has to grow from, on its three pillars: environmental, social and economic, and in all their dimensions. No further explanations will be given then because the effects of sustainable approach are spread throughout the framework. Sustainability for sustainability does not mean anything; so sustainability makes sense when is applied in the different elements of the framework.

5.2.1 LCVP – Life-Cycle Value Proposition

Value Proposition is a recurrent element in business model frameworks. However, life-cycle does not appear mentioned in any element of the frameworks reviewed in the literature. Life-cycle (LC) and Value Proposition (VP) are two separate concepts that in this BMF have been merged deliberately bearing in mind their notable connections in a Product-Service System context. As it has been found in literature life-cycle approach is essential for PSS and here is suggested that this fact has to be considered from the beginning, so the value proposition is conceived thinking about the product-service life-cycle.

The main reason to merge these two broad concepts is because in PSS the VP is just the whole life-cycle. When a provider offers a PSS is offering from the conception or design to the end-of-life of the PSS, so there is no reason for keeping them separately. Furthermore, that dynamic sense in the PSS life, where value proposition can vary at any time because of the customers' requirements, reinforces the interaction between the two ideas.

All this discourse gains force when the ratio service/product rises and the owner of the product is not anymore the client, but the provider. In this case, it is absolutely clear that the value created is spread over all the life-cycle: in the designing, in the maintenance, in the renewing etc.

5.2.2 Customer Behaviour

Without customers there are no companies. Most BM frameworks make reference to customers (customers, target market…), so it is obvious that customers are another key point of the BM, and they are also included in this framework, but under the name "Customer Behaviour". An important characteristic of PSS is that business process is

customer centred due to the strong relationship company-customer. So customer's behaviour will exert significant impact to the implementation and performance of PSS. Customer behaviour is divided in three blocks:

- **Customer preferences**. Being up-to-date with our customers' preferences, needs, problems, worries, interests… is a key point to adapt the value proposition offered, to satisfy them, to anticipate to the competition, and to generate an added value that for sure will reinforce the company-customer ties and confidence; a basic factor in our days. Once customer preferences are known it is possible to segment customers, and even to identify those who at the moment are not customers but could become customers after adapting our value proposition.
- **Usage pattern**. As it has been seen in the literature review, most research on the modelling of PSS does not include the influence of customer behaviour on the life-cycle of a product, but in fact it is essential to consider it, because it has an outstanding impact. Here, it is considered under this label "usage pattern". The consequences in a product are not the same for all usage frequencies, or for all types of skilfulness. Usage pattern has a clear impact in the rhythm of service provision, and in the life-cycle of the product-service.
- **Information flow channels**. They serve two functions: (i) raising awareness among customers or potential customers about a company's PSS offering, and (ii) allowing a fluent communication between company and customer. These communication channels allow companies being aware of the customer preferences as well as the usage pattern.

Proactive companies have started working more closely with their customers, who then depend on them for many types of information. In turn, these companies often have early insights into consumer tastes, preferences and buying habits. Possessing this valuable information let these companies to be in a privileged position with regard to the firms without this close relationship with their clients. Thus, such proactive companies play a critical role in both satisfying and creating consumer preferences for goods and services, including their environmental dimensions.

By means of knowing information about customer preferences and their usage pattern it is possible to establish the definition of customer segments, target customers, as well as the relational strategy the companies aim to establish with each customer, apart from adapting the value proposition for each customer.

Information and Communication Technologies (ICT) – the Internet, social networks… - has had an important impact on channels by increasing the range of them and making new ways of reaching the customer possible. In particular, social networks have gained great importance during the last years, allowing companies to keep a direct contact with customers or potential customers: platforms where people can express opinions and preferences freely, without the influence of the salesman for instance or without the rigidity of a survey. What is more, several companies do not use social networks just for advertising specific products or services, but for transmitting their philosophy or values to customers in order to attract them.

5.2.3 Value Configuration

How the company creates and delivers the value proposition to its customers. The totality of the BM frameworks analyzed in the literature review makes reference at least to some point of the Value Configuration element. It is clear then that a proper definition of the value configuration is essential for the success of a BM. Many aspects are included in this huge element: resources, activities, partnerships and distribution & delivery channels.

Resources

Resources describe the most important assets required to make a business model work. Resources can be physical, financial, intellectual or human. These resources allow an enterprise to create and offer the value proposition, reach markets, maintain relationships with customers, and earn revenues.

Key resources can be owned (in-house resources) or leased by the company or acquired from partners (outsourced resources).

Activities

Activities are the things a company must do to make its business model work, using the resources. As resources, activities are required to create and offer a value proposition, reach markets, maintain customer relationships, and earn revenues. Depending on the type of company key activities required can vary substantially: problem solving – coming up with new solutions to individual customer problems – production, management – e.g. supply chain management – platform or network related activities – developing or maintaining websites …

Partnerships

This element describes the network of suppliers and partners that make the business model work. Companies forge partnerships for many reasons, and partnerships are becoming a

cornerstone of many business models. Companies create alliances to optimize their business models, reduce risk, or acquire resources.

Going on with partnerships, a company can take part of different partner networks at the same time. Often taking part in a supply chain is not an option, it is necessary. But taking part in other more evolved forms of partnerships – as a value network or a virtual factory, explained in 3.4.4.4 – is a way to create sustainable value – social and economic.

Distribution and delivery channels

They allow companies delivering the value proposition to customers, at any moment of the PSS life-cycle (product deliver, customer support, reparations …). Distribution and delivery channels are related to Value Configuration because they are part of the logistics chain of the company.

Even though a clear distinction has been made depending on the utility of channels – distribution and delivery channels and communication channels (in the Customer Behaviour element) – it may happen that a single channel serve both functions at the same time. For example the person in charge of machine maintenance who sees the customer once a month can deliver the value proposition (the machine's maintenance) and take a feedback to the company in terms of opinions, needs and preferences of the customer.

5.2.4 Value Capturing Structure

Because a firm devises a strong value proposition and successfully creates and delivers that value does not mean it will earn superior returns, or even be viable. So capturing the value is as important as creating it, and with a suitable designed structure. The importance of this item is then obvious.

In PSS, so from a sustainable point of view, value capturing has two different aspects:

- Economic value capture: the cash a company generates from each customer segment.

EARNINGS = REVENUES - COSTS

- Non-Economic value capture. Other types of value that at least directly do not result in cash.

Economic value capture

The financial aspects are the culmination of a business model. A proper model that produces revenue and provides for a profit margin over its cost is necessary. This component of the business model includes what is often called the revenue model as well as the costing model. The revenue model describes the sources of revenue or different ways that the firm receives money in exchange for its services. The costing model covers the costs, margins, and various financial aspects of the firm.

Revenue model

A company must ask itself: *For what value is each customer segment truly willing to pay?* Successfully answering that question allows the firm to generate one or more revenue stream from each customer segment. Each revenue stream may have different pricing mechanisms. The type of pricing mechanism chosen can make a big difference in terms of revenues generated. There are two main types of pricing mechanism: fixed and dynamic pricing. Dynamic such as bargaining, auctioning, market dependent, volume dependent or yield management.

Costing model

The earnings of the company are the revenues subtracting the costs. The costing model describes the costs incurred while operating under a particular business model. Creating and delivering value, maintaining customer relationships, and generating revenue all incur costs.

So far, in the costing model there has not been any discussion about PSS or sustainability. It has been presented a general approach. But if shifting to a sustainable business model implies its whole reformulation, also the costing model has to be adapted. In other parts of the BM it may be easier to identify methods in order to be more sustainable, but in the costing model it is not evident. Sustainable-accounting methods should be implemented to enable a proper analysis of the whole business, in order to properly prioritize a list of likely interventions and to make better decisions to head for higher level of sustainability. The scope should be to identify the sources of inefficiency of the process, so being able to act onto the right point.

On the light of the above, as it has been stated in the literature review, some research has been done about environmental accounting, life-cycle costing and eco-efficiency, but not much about social sustainability costing.

Non-economic value capture

Environmental or social values may be interesting for firms, which then – why not – can evolve to economic returns (because the brand force has gained force in socio-environmental terms and more clients decide to trust the company or whatever). Here the way in which non-economic value is captured should be defined as well as the importance of these values' benefits.

Obviously, there is nothing for free, and having a non-economic return also has a cost that can be non-economic, but usually it is economic.

6. TOOLKIT TO BUILD A PSS BUSINESS MODEL

This chapter deals with tools to build a PSS business model based on the BMF for PSS presented above, in chapter 5. The final result of this chapter will be a toolkit covering as many key aspects of the BMF designed as possible; in order to allow companies and interested people to develop a real PSS BM. Section 6.1 deals with the selection of the tools of the toolkit. It starts with a list of possible tools to include in the toolkit and they are classified according to criteria and indicators that will be explained thoroughly. Then, a selection for the toolkit is done. Finally, section 6.2 provides a brief description of each of the tools in the list, those in the toolkit and those not included.

6.1 CRITERIA & SELECTION OF THE TOOLS

After all the research of best practice in sustainable PSS methodology and tools, a low complex and easily accessible list of tools to run a PSS design project for companies is presented here. It is a compilation and synthesis of the researched methods and tools, and all the proposed tools aim to be useful for companies in the design of a PSS business model. In the list, there are some tools from Suspronet compiled methodologies, common tools used in business practice, and other interesting tools found in the literature.

There are seven indicators in which every tool has been classified. They are presented next.

- **Step.** The topic the tool deals with. The entire business model designing process has been divided into 6 steps, including the 5 elements of the BMF for PSS and also the 'stakeholders' identification' as a first step. Before starting with the design of the business model a proper identification of the stakeholders is essential, according to the business ecosystem approach. So, the steps are:

  a. Stakeholders' identification
  b. Customer behaviour
  c. LCVP (Life-Cycle Value Proposition)
  d. Value configuration
  e. Value capturing structure
  f. Sustainability assessment

  The different steps can be seen as a sequential process; so the first thing to do is to identify stakeholders, then to analyze the customer behaviour, and so on. However, depending on the situation (e.g. if the business model is being designed or it is being

analyzed) the order may change easily and some steps may be repeated iteratively. Special features of sustainability in the BMF for PSS must be taken into account: although 'sustainability' is a background element (see section 5.2) and it is implicit in all the rest of BM elements, it is included as a step (under the name of 'Sustainability assessment') for those tools that do not apply to any of the other steps but only for sustainability in general – for instance a sustainability analysis of the business.

To be defined properly each step may need a variety of tools, given that some of them include several topics to be dealt with different tools. It often happens that a tool is quite flexible and can be useful for more than one step. The tools provided in the list aim at covering most of the aspects of the business model, though in the literature there are some gaps in certain aspects.

- **Time consuming**. Referred to the time needed for using the tool, in an approximate way.
    a. Less than a day
    b. Between 1 day and 1 week
    c. More than 1 week

- **Developing personnel needed**. The type of people needed when putting into practice the tool.
    a. A multi-disciplinary group is required/better.
    b. A non multi-disciplinary group is enough/better.

In terms of number of people needed it is not worthy making a classification because any tool may be developed by one person or by a larger group. Probably, developing a tool with a larger group of people is advisable because of the variety of points of view provided by the participants.

- **Value perspective**. If economic value is only considered or also social or environmental value are considered.
    a. Only economic.
    b. It considers at least another kind of sustainable value: social and environmental.

- **Ecosystem concerning.** If the tool only concerns the company view or has a wider perspective of actors within the business ecosystem.

a. No, only the company view.

b. Yes, it concerns part/the whole business ecosystem.

- **Innovation & creativity stimulation**. If the tool stimulates innovation and creativity beyond the obvious or is limited in this sense.
    a. No, innovation and creativity stimulation is limited.
    b. Yes, the tool stimulates innovation and creativity.

- **Skills required**. The skills required when putting into practice the tool.
    a. Standard skills, general knowledge.
    b. Highly specialized skills.
    c. External consulting services may be required / useful.

The nature of the first indicator, 'step', is absolutely different from the nature of the other ones. 'Step' classifies tools according to the scope of the tool; why is it used for. However, the rest of the indicators categorize tools according to their practical aspects and features (time consuming, skills required…). According to these different natures of the indicators, a two dimensions classification matrix could be fulfilled for each tool. Table 11 displays the template of this two-dimensional matrix, and it has to be fulfilled using ticks.

However, even if the template in Table 11 is a logical way to classify tools, here we have chosen to integrate all the information related to the seven indicators at the same table. In the vertical axis there are the names of the tools; in the horizontal axis there are the seven indicators, and inside the boxes the classification is made using indexes (a. b. c. …). Table 12 contains this classification.

Finally, another table is presented (Table 13) in order to visualize easily which element of the BMF for PSS each tool is suitable for. Tools are presented vs. the elements of the BMF. A column called "Sustainability approach" is added to visualize if the tool deals with some of the pillars of sustainability. Some tools may be useful for more than one element, and this table highlights these cases.

Table 11 – Two dimensional matrix template to classify each tool.

TOOL's NAME		Stakeholders's identification	Customer behaviour	LCVP	Value configuration	Value capturing structure	Sustainability assessment
Time consuming	Less than a day						
	Between 1 day and 1 week						
	More than 1 week						
Developing personnel needed	A multi-disciplinary group						
	Non multi-disciplinary group						
Value perspective	Only economic						
	At least another kind of sustainable value is considered						
Ecosystem concerning	No, only the company view						
	Yes, it concerns the ecosystem						
Innovation & creativity stimulation	No, stimulation is limited						
	Yes, innovation and creativity are stimulated						
Skills required	Standard, general knowledge						
	Highly specialized skills						
	External consulting services may be useful						

Table 12 – Tools' classification: tools vs. indicators.

TOOL	Step	Time Consuming	Developing personnel needed	Value perspective	Ecosystem concerning	Innovation & Creativity stimulation	Skills required
Adapted Fishbone Diagram	d	a	a	b	b	b	a
Blueprinting Model	c/d	b	b	-	a	b	a
Business Ecosystem Map	a	a	b	b	b	a	a
Causal Loop Diagram	c	a	b	a	a	a	a
Cost-benefit analysis	e	c	b	a	a	a	a
ERRC Grid	c	-	a	a/b	a/b	b	a
ExtABEC	e	c	b	b	a	a	b/c
Fishbone Diagram	c	a	a	-	-	b	a
Four Actions Framework	c	-	a	a/b	a/b	b	a
IDEF0	d	b	a	-	b	-	b
Inventory Sustainability Indicators	f	a	a	b	b	b	a/b
Life-cycle frameworks	c/d	a	b	b	b	a	a
Osterwalder-Pigneur canvas	d	b	a	a	b	a	c
Persona	b	c	b	b	a	b	a
Product Life Gallery	c/d	a	a	b	b	b	a
Scenario Planning	c	b	a	-	b	b	b
Stakeholder Analysis	a	a	a	b	b	a	a
SWOT Analysis	c	a	a	b	b	b	b
System Platforms	d	b	a	-	b	a	b
Value Framework Model	c	b	a	b	b	b	a
Value Network Analysis	c/d/e	a	b	b	b	-	a/b

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Table 13 – Tools' classification: tools vs. elements of the BMF for PSS.

TOOLS FOR THE ELEMENTS OF THE BMF FOR PSS	Stakeholders' identification	Customer Behaviour	LCVP (Life-Cycle Value Proposition)	Value Configuration	Value Capturing Structure	Sustainability approach
Adapted Fishbone Diagram				✔		✔
Blueprinting model			✔	✔		
Business Ecosystem Map	✔					✔
Causal Loop Diagram			✔			
Cost-benefit analysis					✔	
ERRC Grid			✔			
ExtABEC					✔	✔
Fishbone Diagram			✔			
Four Actions Framework			✔			
IDEF0				✔		
Inventory Sustainability Indicators						✔
Life-cycle frameworks			✔	✔		✔
Osterwalder-Pigneru canvas				✔		
Persona		✔				
Product Life Gallery			✔	✔		✔
Scenario Planning			✔			
Stakeholder Analysis	✔					✔
SWOT Analysis			✔	✔	✔	✔
System Platforms				✔		
Value Framework Model			✔			✔
Value Network Analysis			✔	✔	✔	

Once having classified the list of tools according to the different indicators, it is time to select those tools that are suitable for the toolkit to develop a business model based on the BMF for PSS.

The chosen criteria to select the suitable tools are of a higher level than the seven previous indicators and they can be considered as aggregated factors for this selection as they summarise the results provided by the previous study of criteria. The criteria consist of three factors:

a. **Transversal tools.** Tools covering various elements of the BMF for PSS. Table 13 evidences that. These types of tools are really interesting as once a tool has been used it is more efficient to use the same tool (already known) to study another element of the BMF. Furthermore, it is considered that those tools stimulating innovation and creativity can be seen as potential transversal tools, because creativity can be easily addressed to various elements of the BMF.

b. **Tools addressing sustainability and multi-stakeholders approaches.** If a tool addresses any of these essential topics of the BMF for PSS, it means the tool is useful to develop a BM in a PSS context.

c. **Easy and affordable tools.** All the tools included in the initial list are quite simple and do not require any software. Even though, the toolkit tries to be easily comprehensible and affordable for anybody interested on the topic, including small and medium enterprises (SMEs), so those tools that can be developed with a reduced group of people and within a relatively short time period will be selected.

Those tools that meet one or more of these factors will receive preference to be considered in the toolkit. However, since in the literature there are several gaps in the tools to develop some aspects of the BMF for PSS, other tools may be accepted and included in the toolkit even though they may not meet this three factors criteria. Apart from that, a qualitative analysis of the content of the tools will be done, in order to choose the most interesting ones.

Figure 10 shows the connections between criteria for the selection of the tools for the toolkit. Both levels of criteria are evidenced in the figure: the lower level (indicators) and the higher level (aggregated factors).
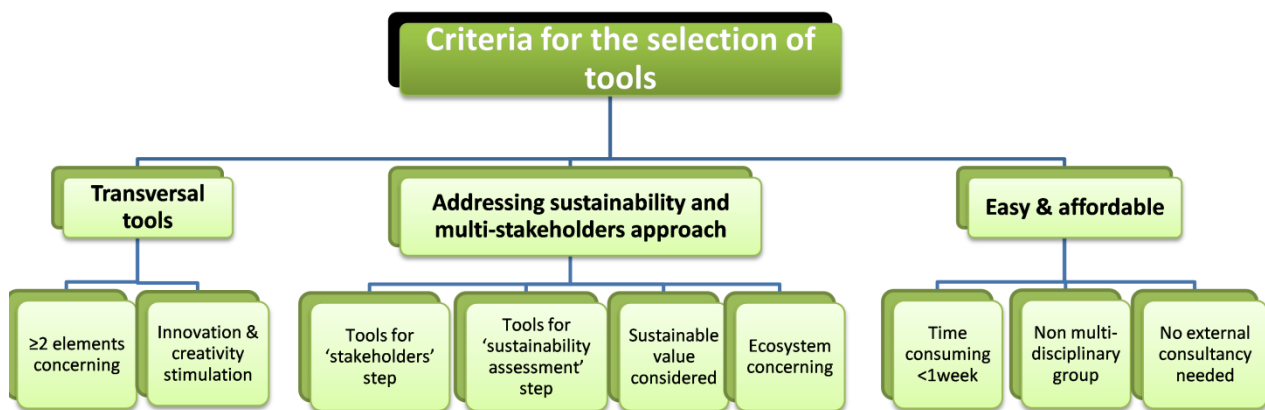
Figure 10 – Criteria for the selection of tools.

Thus, taking into account the aggregated criteria and the qualitative analysis for each tool, the selection of the best tools is done. The tools that constitute the toolkit to develop a BM based on BMF for PSS are:

- Adapted Fishbone Diagram
- Blueprinting Model
- Business Ecosystem Map
- ERRC Grid
- ExtABEC
- Four Actions Framework
- Inventory Sustainability Indicators
- Life-cycle frameworks
- Persona
- Scenario Planning
- Stakeholder Analysis
- Value Framework Model
- Value Network Analysis

Next table, Table 14 is similar to Table 13 but only the selected tools for the toolkit appear. This way, the toolkit can be visualized together with the step each tool is useful for. In the column 'Sustainability assessment' there is only a tick in case it is a specific tool to analyze sustainability aspects, like "Inventory Sustainability Indicators", which do not address any of the other elements in particular.

Table 14 – Tools of the toolkit vs. elements of the BMF for PSS.

TOOLKIT TO DEVELOP A BM BASED ON THE BMF FOR PSS. RELATION WITH BMF ELEMENTS & STEPS.	Stakeholders' identification	Customer Behaviour	LCVP (Life-Cycle Value Proposition)	Value Configuration	Value Capturing Structure	Sustainability assessment
Adapted Fishbone Diagram				✔		
Blueprinting model			✔	✔		
Business Ecosystem Map	✔					
ERRC Grid			✔			
ExtABEC					✔	
Four Actions Framework			✔			
Inventory Sustainability Indicators						✔
Life-cycle frameworks			✔	✔		
Persona		✔				
Scenario Planning			✔			
Stakeholder Analysis	✔					
Value Framework Model			✔			
Value Network Analysis			✔	✔	✔	

6.2   SHORT DESCRIPTION OF THE TOOLS

In the following pages each tool analyzed in this work is presented, those chosen in the toolkit but also the not included ones but that they have analyzed throughout section 6.1. Main aspects of the tools are explained, and references are provided for further information. Throughout these pages the order to present the tools is established by their name, following an alphabetical order, except for the *Four Actions Framework* and the *ERRC Grid* that are presented in section 6.2.2 – Blue Ocean Strategy tools.

6.2.1 Adapted Fishbone Diagram

The structure of this tool is similar to the Fishbone Diagram; both analyze process dispersion. The difference is in the goal: instead of finding the root causes of a problem, now the goal is to describe how to perform a positive idea, how to create a value; so it is a strong tool to help designing the Value Configuration element (of the BMF for PSS), establishing in the right place and position for the activities, resources and partnerships for instance.
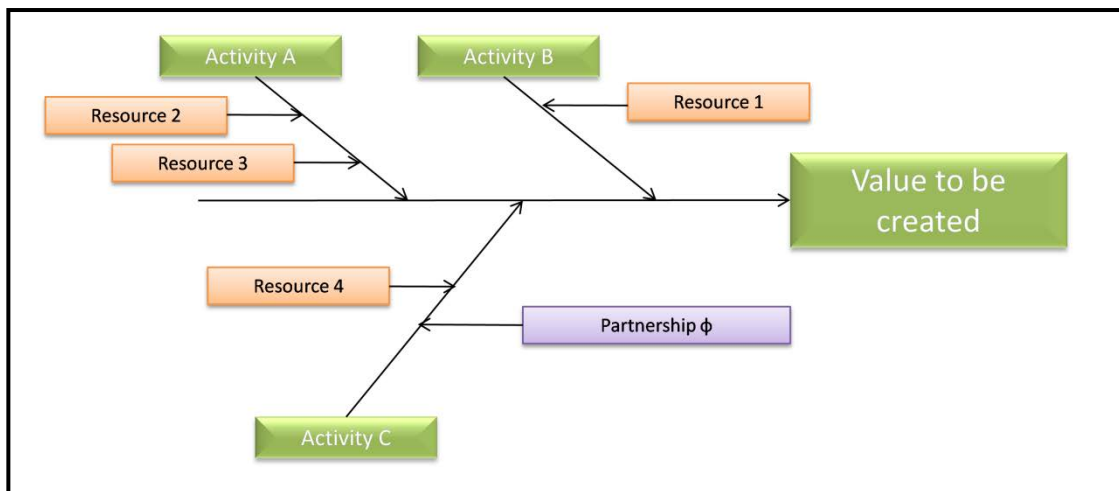

Figure 11 – Adapted Fishbone Diagram.

6.2.2 Blue Ocean Strategy tools

The Blue Ocean Strategy is not a specific tool but a philosophy, and it includes several tools. Two of them have been included in the toolkit and they are presented in sections 6.2.2.1 and 6.2.2.2. A metaphor is used to allow understanding the idea of the Blue Ocean Strategy. The metaphor of red and blue oceans describes the market universe.

Blue Ocean: it is an analogy to describe the wider, deeper potential of market space that is not yet explored. Denotes all the industries not in existence today – the unknown market space, untainted by competition. In blue oceans, demand is created rather than fought over. There is ample opportunity for growth that is both profitable and rapid. In blue oceans, competition is irrelevant because the rules of the game are waiting to be set.

Red Ocean: they are all the industries in existence today – the known market space. In the red oceans, industry boundaries are defined and accepted, and the competitive rules of the game are known. Here companies try to outperform their rivals to grab a greater share of product or service demand. As the market space gets crowded, prospects for profits and growth are reduced. Products become commodities or niche, and cutthroat competition turns the ocean bloody. Hence, the term *red oceans*.

The aim of BOS is not to out-perform the competition in the existing industry, but to create new market space or a blue ocean, thereby making the competition irrelevant. BOS offers systematic and reproducible methodologies and processes in pursuit of blue oceans by both new and existing firms.

Table 15 – Blue and Red Ocean characteristics.

Red Ocean Strategy	Blue Ocean Strategy
Compete in existing market space	Create uncontested market space
Beat the competition	Make the competition irrelevent
Exploit existing demand	Create and capture new demand
Make the value-cost trade-off	Break the value-cost trade-off
Align the whole system of a firm's activities with its strategic choice of differentiation *or* low cost	Align the whole system of a firm's activities in pursuit of differentiation *and* low cost

Although blue ocean strategists have always existed, for the most part their strategies have been largely unconscious. Blue ocean strategy seeks to remedy this by not only decoding the pattern and principles behind the successful creation of blue oceans, but also providing the

analytical frameworks and tools to act on this insight. BOS toolkit include several tools: strategy canvas, value curve, four actions framework, six paths, buyer experience cycle, buyer utility map, and blue ocean idea index.

Reference: The Blue Ocean Strategy Network (BOSN) is a global community of practice on the Blue Ocean Strategy (BOS) family of concepts and methodologies created by W. Chan Kim & Renee Mauborgne. Further information can be found here http://www.blueoceanstrategy.com (24/07/2012)

6.2.2.1 Four Actions Framework

This tool is used to reconstruct buyer value elements in crafting a new value curve. As shown in the diagram below, to break the trade-off between differentiation and low cost and to create a new value curve, there are four key questions to challenge an industry's strategic logic and business model:
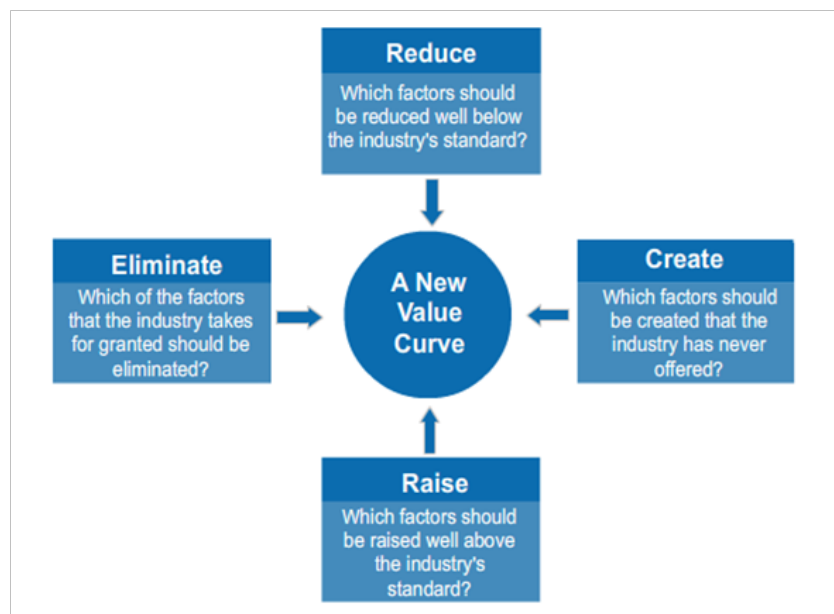

Figure 12 – The Four Actions Framework.

Reference: The Blue Ocean Strategy Network http://www.blueoceanstrategy.com (24/07/2012).

6.2.2.2 ERRC Grid

The Eliminate-Reduce-Raise-Create Grid (ERRC) is complementary with the *Four Actions Framework*, and it is key to creation of blue oceans. The grid pushes companies not only to ask all four questions in the *Four Actions Framework* but also to *act* on all four to create a new value curve, essential for unlocking a new blue ocean. By driving companies to fill in the grid with the actions of eliminating and reducing as well as raising and creating, the grid gives companies four immediate benefits:

- It pushes them to simultaneously pursue differentiation and low cost to break the value-cost trade off.

- It immediately flags companies that are focused only on raising and creating and thereby lifting the cost structure and often over-engineering products and services – a common plight in many companies.

- It is easily understood by managers at any level, creating a high level of engagement in its application.

- Because completing the grid is a challenging task, it drives companies to robustly scrutinize every factor the industry competes on, making them discover the range of implicit assumptions they make unconsciously in competing.

Eliminate	**Raise**
Which factors can you eliminate that your industry has long competed on? List those here...	Which factors should be raised well above the industry's standard? List those here...
Reduce	**Create**
Which factors should be reduced well below the industry's standard? List those here...	Which factors should be created that the industry has never offered? List those here...

Figure 13 – Eliminate – Reduce – Raise – Create Grid.

Reference: The Blue Ocean Strategy Network http://www.blueoceanstrategy.com (1/09/2012).

6.2.3 Business Ecosystem Map

The Business Ecosystem Map proposed in section 5.1 is can be a very useful tool to identify the stakeholders of a company. Figure 14 displays the map and it has to be used as a source of inspiration in order to make a proper identification of those organizations or groups defining the company's ecosystem. To determine stakeholders the important part of the figure is the central one (the blue bubbles). Arrows and aspects related to the organization of the business ecosystem may not be so important for the identification of the stakeholders. The blue bubbles try to stimulate the tool's user to reflect on the real group of stakeholders.
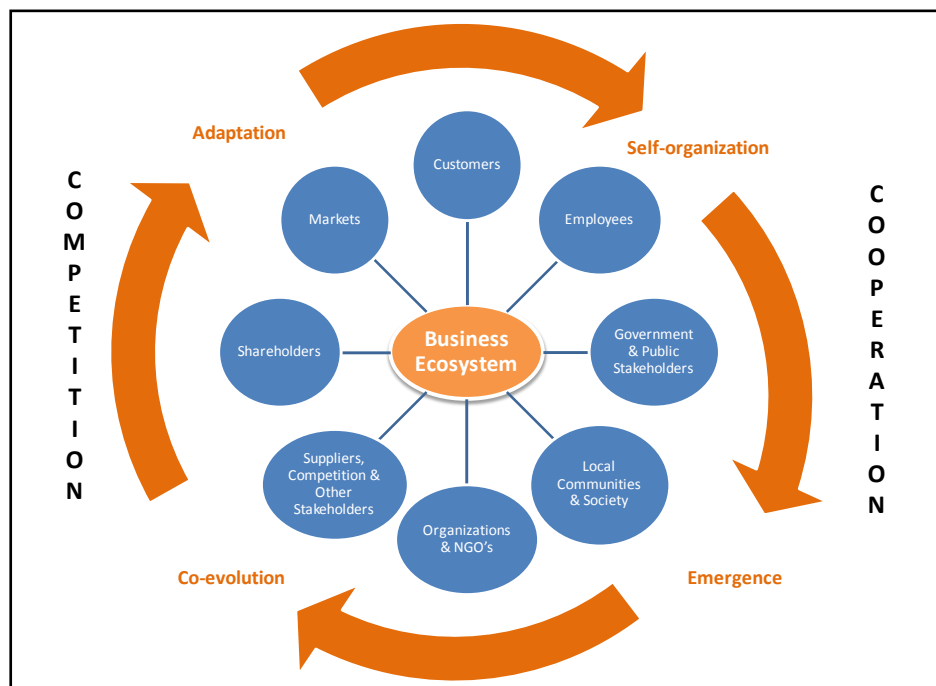
Figure 14 – Business Ecosystem Map.

6.2.4 Blueprinting model

Blueprinting is a method invented to visualize service processes. It is a customer-focused approach for service innovation and service improvement, and it allows companies to visualize the service processes, points of customer contact, and the physical evidence associated with their services from their customers' perspective. Blueprints also illuminate and connect the underlying support processes throughout the organization. Anyway, its most important feature is that of showing the customer's role in the service process. It is also a suitable tool to help defining channels (both information flow channels, and distribution and delivery channels).

Allows a description of critical service elements; such as time, logical sequences of actions, and processes, also specifying both actions and events that happen in the time and place of the interaction (front stage), and actions and events that are out of the line of visibility for users, but are fundamental for the delivery of the service (backstage).

There are five components of a typical service blueprint (see Figure 15 for a diagram of key components):

Figure 15 – Components of the Blueprinting model.

- **Customer actions**: include all of the steps that customers take as part of the service delivery process. They are depicted chronologically across the top of the blueprint. They are typically laid out first, so they are central to the creation of the blueprint.

- **Onstage/Visible contact employee actions**. Those actions of frontline contact employees that occur as part of a face-to-face encounter. They are separated from customer actions by the line of interaction. Every time the line of interaction is crossed via a link from the customer to a contact employee, a "moment of truth" has occurred.

- **Backstage/Invisible contact employee actions**. Separated from the onstage actions by line of visibility. Everything that appears above the line of visibility is seen by the customer, while everything below it is invisible. Below the line of visibility, all of the other contact employee actions are described, both those that involve non-visible interaction with customers (e.g., telephone calls) as well as any other activities that contact employees do in order to prepare to serve customers or that are part of their role responsibilities.

- **Support processes**. Separated from contact employees by the internal line of interaction. These are all of the activities carried out by individuals and units within the company who are not contact employees but that need to happen in order for the service to be delivered.

- **Physical evidence**. These are all the tangibles that customers are exposed to that can influence their quality perceptions. For each customer action, and every moment of

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truth, the physical evidence that customers come in contact with is described at the very top of the blueprint.

When building a blueprint, the first step is to clearly define the service process or sub-process to be blueprinted. Once this has been decided, the actions of customers should be delineated first because this component serves as the foundation for all other elements of the blueprint. Then, the contact employee actions, both onstage and backstage, can be delineated, followed by support processes. At this point, links can be added that connect the customer to contact employee activities and to needed support functions. Physical evidence is typically the last component added to the blueprint. Blueprints are ideally developed by multi-disciplinary teams, possibly even involving customers.

The level of detail depicted in the blueprint is a function of the purpose for which it is being created. Fig. 16 is an example of a blueprint for a one-night hotel stay. If desired, additional boxes could be added to show each of the underlying steps in more detail. The goal is to capture the entire customer service experience from the customer's point of view in the blueprint. Although presented only in a brief conceptual form here, any support processes that impact the customer experience could be described in detail. As shown in the blueprint, hotels clearly have considerable physical evidence that customers are exposed to, that can impact their quality perceptions.
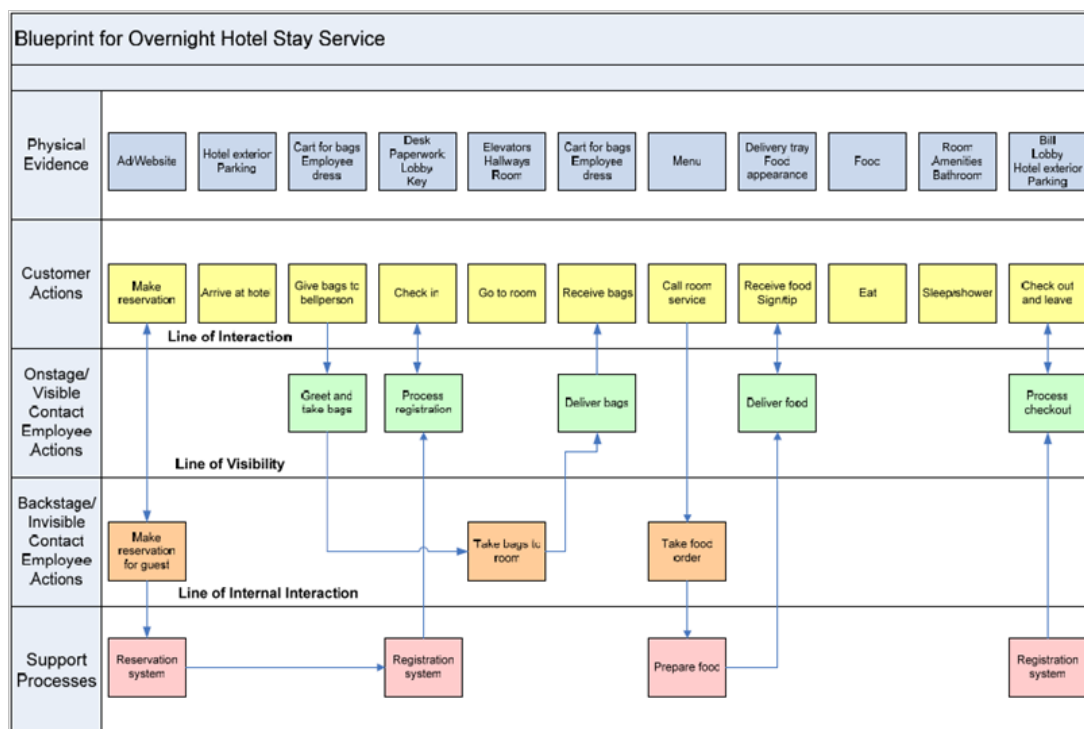

Figure 16 – Blueprint for an overnight hotel service.

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References: Fliess *et al.* (2006), Bitner *et al.* (2007).

6.2.5 Causal loop diagram

A causal loop diagram is a useful way to represent business models, where choices and consequences are linked by arrows based on causality theories. Business models often generate virtuous cycles, feedback loops that strengthen some components of the model at each iteration.

While virtuous cycles are not part of the definition of a business model, they can be crucial elements in their successful operation. As the cycles spin, rigid consequences become more significant, and such virtuous cycles can develop valuable resources and capabilities.
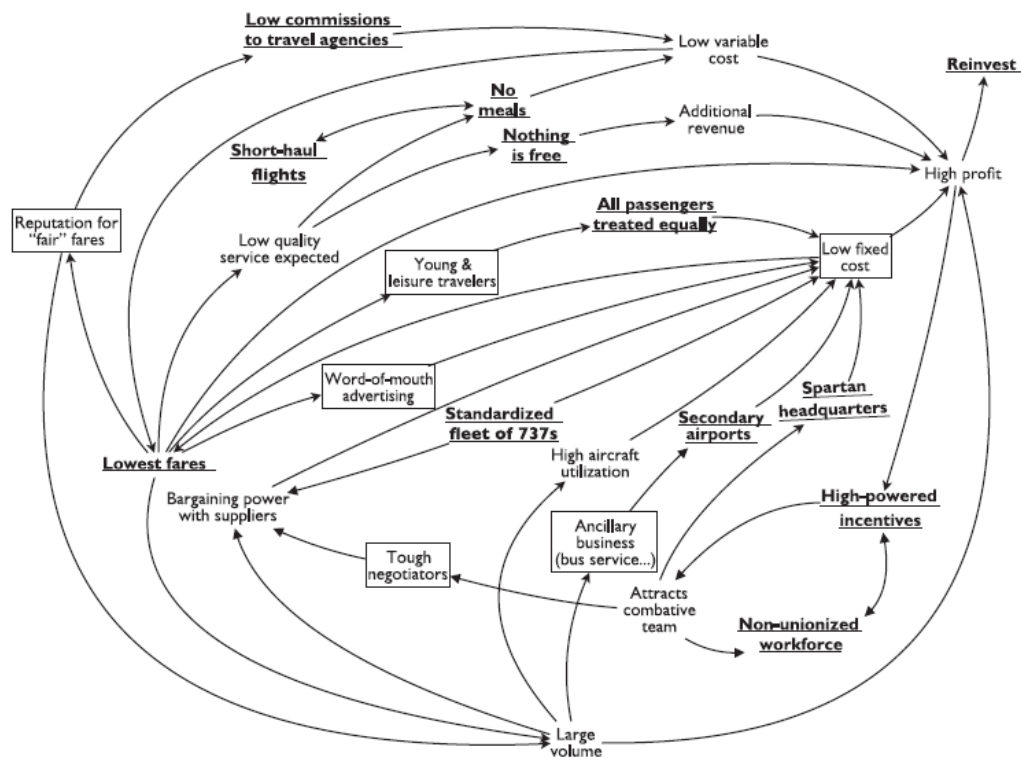

Figure 17 – Ryanair business model representation.

Underlined elements are choices and non-underlined elements are consequences. Consequences in boxes are 'rigid,' those not in boxes are 'flexible'. A consequence is flexible if it is highly sensitive to the choices that generate it. For example, 'large sales volume' is a consequence of the policy choice 'low prices' - if the policy were to change to high prices, volume would be likely to fall rapidly.

In contrast, a rigid consequence is one that does not change rapidly with the choices that generate it; thus a 'reputation for ''fair'' fares' is a consequence that changes only slowly with changes in the choices that generate it.

Reference: Casadesus & Ricart (2010).

6.2.6 Cost benefit analysis

Cost-benefit analysis is a tool for comparing the benefits of proposed projects with the costs, to help users identify the alternative with the maximum net benefit (benefits minus costs). There are four basic steps to performing a cost-benefit analysis:

- Identify the project or program and alternatives.
- Describe quantitatively the inputs and outputs of each alternative.
- Estimate the value of the costs and benefits.
- Compare benefits and costs.

Cost-benefit analysis, when done correctly, can give a better understanding of the impact of alternative courses of action in terms of costs and benefits. This knowledge can help to identify alternatives that are the most beneficial, comparing projects that differ in magnitude and dimension.

Cost-benefit analysis requires the conversion of all benefits and costs into common units – typically money (€, $...). It often happens that costs are easier to estimate than benefits. Because many environmental or social outputs cannot easily be measured in monetary terms, it may be possible to apply this tool in only a limited range of project decisions.

Although this analysis is widely accepted by society and it often simplifies complex concepts, it can be time-consuming and expensive, and it does not usually consider how costs and benefits are distributed across different groups.

Reference: http://www.hd.gov/HDdotGov/detail.jsp?ContentID=297 (17/09/2012).

6.2.7 ExtABEC – Extended Activity-Based Environmental Costing

ExtABEC is an environmental costing method to enable a proper analysis of the flows of products, by-products and wastes produced by a whole production plant or simply by a section of this plant. Thanks to detail given by this method, it is actually possible to go back to the sources of inefficiency of the process and to simulate the impact of likely eco-efficiency interventions in a what/if approach. So it helps to prioritise the list of likely interventions and to make better decisions to head for higher level of eco-efficiency, hence sustainability.

The structure of the cost-accounting model is represented in Fig. 18(a). In an ABC view, it is fundamental to distinguish both those costs that it is possible to directly account to the cost objects and those ones that are accounted by means of activities. Each process, depending on the degree of detail, is broken down into activities represented by templates (Fig. 18(b)).

From Fig. 18(a) it is noteworthy that wastes and by-products absorb resources in the same way as the expected products. In this way, to each cost object the consumption of all the resources used is accounted, independently from the fact that the output is a waste or a sellable product. Overheads are accounted by means of total production cost (net production cost + waste costs). In this way, a process that has as an output, a product but also a relevant flow of waste, has a greater quote of overheads.
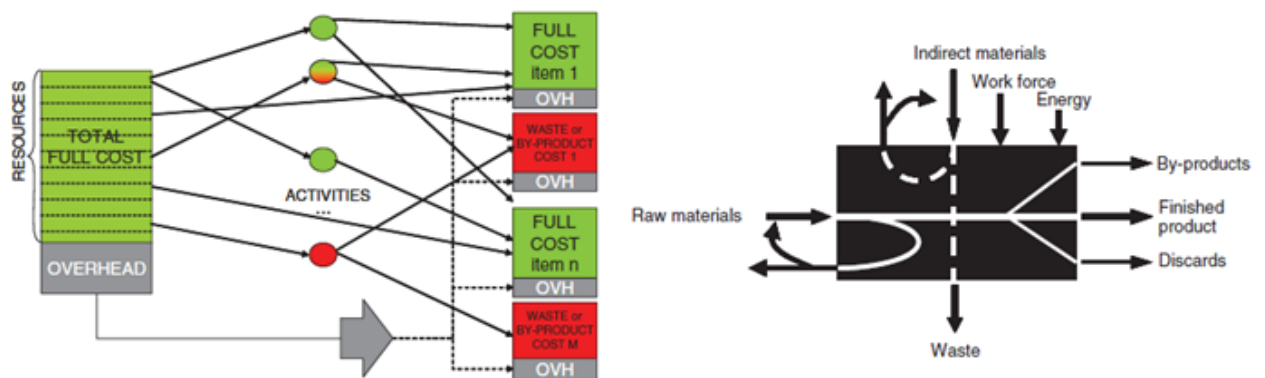

Figure 18 – (a) ExtABEC model; (b) Template of an activity.

For a full estimate of the costs it is necessary a large knowledge of the production process. The detailed analysis of the processes, of the cost objects and the identification of the proper drivers is quite time-consuming; and the estimate of the flows of resources, products, by-products and wastes can be very expensive unless a management system already exists.

Reference: Cagno *et al.* (2012).

6.2.8 Fishbone Diagram

The Fishbone Diagram is a tool for analyzing process dispersion. It is also referred to as the "Ishikawa diagram" because Kaoru Ishikawa developed it. The diagram illustrates the main causes and sub-causes leading to an effect (symptom). It is a team brainstorming tool used to identify potential root causes to problems. Because of its function it may be referred to as a cause-and-effect diagram. In a typical Fishbone Diagram, the effect is usually a problem needs to be resolved, and is placed at the "fish head". The causes of the effect are then laid out along the "bones", and classified into different types along the branches. Further causes can be laid out alongside further side branches. So the general structure of a fishbone diagram is presented below.
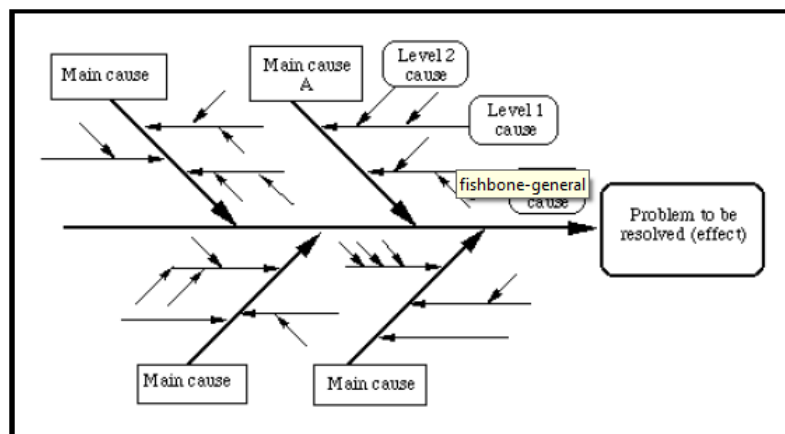

Figure 19 – General structure of a fishgone diagram.

The main goal of the Fishbone diagram is to illustrate in a graphical way the relationship between a given outcome and all the factors that influence this outcome. The main objectives of this tool are:

- Determining the root causes of a problem.
- Focusing on a specific issue without resorting to complaints and irrelevant discussion.
- Identifying areas where there is a lack of data.

6.2.9 IDEF0

IDEF0 is a method to represent a sequential view of a system through examining an event and unfolding it into sequences of sub events. This allows the organisation of tasks by inputs, outputs, controls and mechanisms for each task to be performed. This technical representation technique is a way for the designer to analyse the system in its details, without losing sight on the overall systemic configuration. The use of the technique depends on viewpoints and the purposes, and therefore each representation requires a stated viewpoint and clear idea of the task to be performed by the system. The representation format is based on well defined rules; it is flow oriented and directional. This helps the interpretation once the rules are clear. IDEF0 is widely used to gain overview and understanding of the main tasks performed by the system.
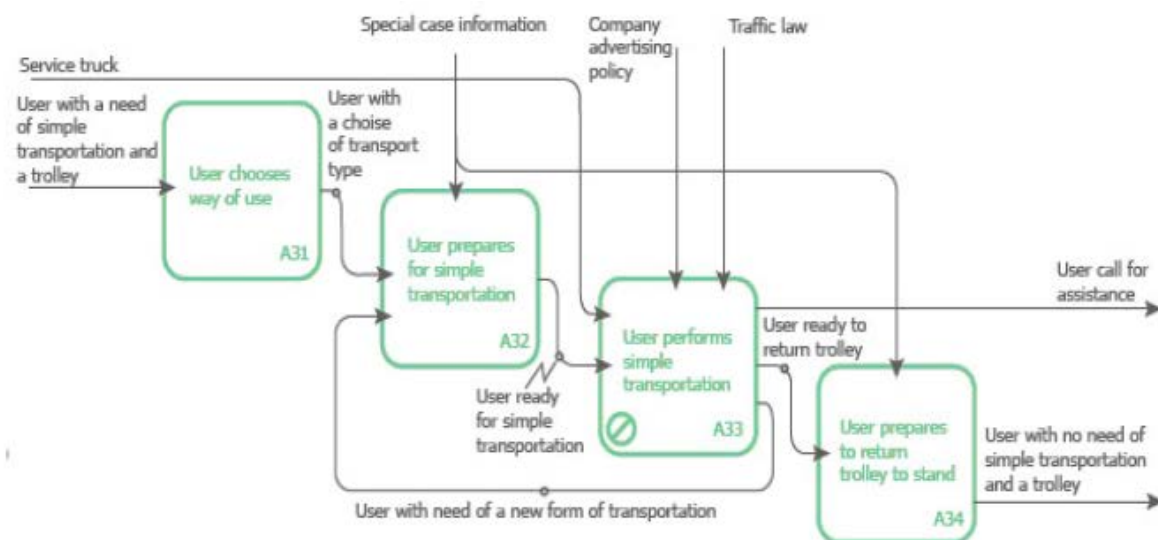

Figure 20 – IDEF0 used in a students' project on a shared bicycle trailer service. The service is described as a "production system" in which the customer is co-producer.

Reference: Morelli *et al.* (2007).

6.2.10 Inventory Sustainability Indicators

This tool helps to gain a better overall understanding of the sustainability aspects and to identify relevant indicators. When implemented in a workshop, it is useful to divide the group in subgroups, to work separately for a short time (e.g., 15 minutes), and then to consolidate the results to obtain a final selection of aspects and related indicators.

The process to follow is to identify within each dimension of sustainability (environmental, social and economic) the relevant categories and the relevant aspects for the company. The aspects should be detailed enough to enable you to pinpoint the relevant supporting indicators. Categories and aspects can be identified spontaneously or using existing frameworks to make sure that no important sustainability aspects are missed. These existing frameworks include public sustainability guidelines like GRI, World sustainability council, Compass, IPPC directives …
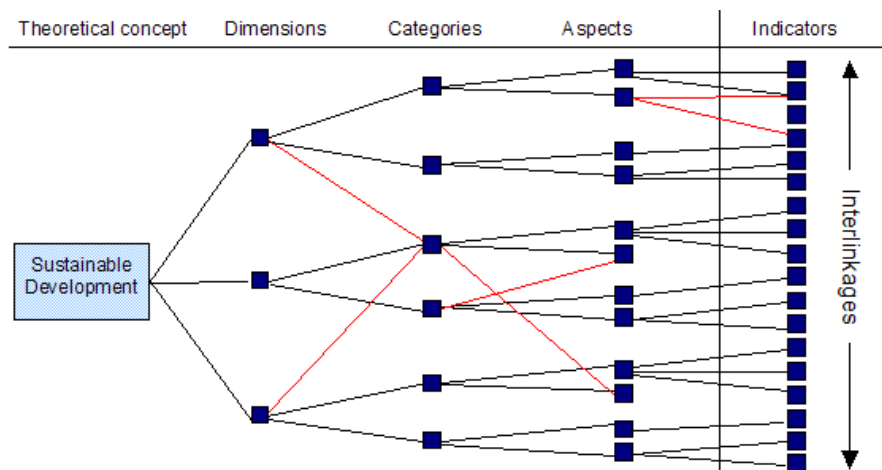

Figure 21 – The result of this tool is a diagram with the dimensions, relevant categories, aspects and indicators.

The last step is to link the aspects to quantifiable indicators, which when measured give an idea of the impact that an activity (or the whole business) has over an aspect.

- For the environmental aspects, a great amount of methodologies are available (indicators for SO_x, NO_x and heavy metals are some examples for the air quality).
- For the social aspects, some creativity may be needed, but most are quite simple to identify; for instance, employment can be expressed as the number of jobs created (directly and indirectly).
- For the economic aspects, many indicators are available, such as return on investment.

Reference: www.mepss.nl (16/08/2012).

6.2.11 Life-Cycle frameworks

As it has already been explained in the literature review, in different types of PSS, product and service have different levels of importance. The general classification of PSS will be used: Product-Oriented, Use-Oriented and Result-Oriented PSS. And so, depending on the ratio product/service (or tangible/intangible), the suitable life-cycle framework varies.

Generally speaking in Product-Oriented PSS, product is core part whilst service is designed and provided according to the life-cycle of the physical product; service options are part of the product life-cycle. For this type of PSS the life-cycle framework 'Integrated Manufacturing and Product Service System (IMPSS)' presented in section 3.3.4, by Mien *et al.* (2005) fits perfectly. Figure 22 displays this framework. This framework identifies several stages of product life-cycle and services around these stages. It does not fit for the others PSS' types, but it is suitable for traditional manufacturers to add services to their products. It upgrades an old business model to a new PSS model.
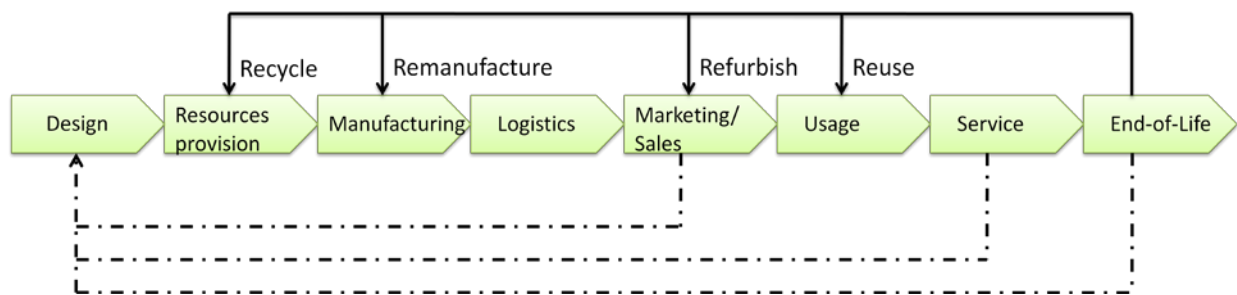

Figure 22 – IMPSS. Life-cycle model for Product-Oriented PSS. (Source: Mien *et al.*, 2005).

In Use-Oriented PSS, the product's function is to provide services to customers. In Result-Oriented PSS, service can replace product to provide desired results to customers. So in both types, service is core part, and plays a more important role than the product. Therefore, the stages for product life-cycle presented above do not fit properly in services. Furthermore the framework of IMPSS does not reflect customers' perspectives and behaviour.

The life-cycle framework chosen for use-oriented and result-oriented PSSs is the one by Lujing *et al.* (2010), which presents a service life-cycle perspective integrating product life-cycle (see section 3.3.4).

However, from our point of view, this model fails in its static approach of the PSS. The term 'evaluation' which only appears in the last stage should gain a more important role and be omnipresent in the whole life-cycle. PSS is customer-centred and the relationship between

company and costumer is very close, evolving to some kind of partnership. So obtaining the feedback of the client may occur at any time, and it is important for the life-cycle model to capture this idea of dynamism. Figure 23 displays the modified Lujing *et al.* (2010) life-cycle model, suitable for Use-Oriented and Result-Oriented PSSs.
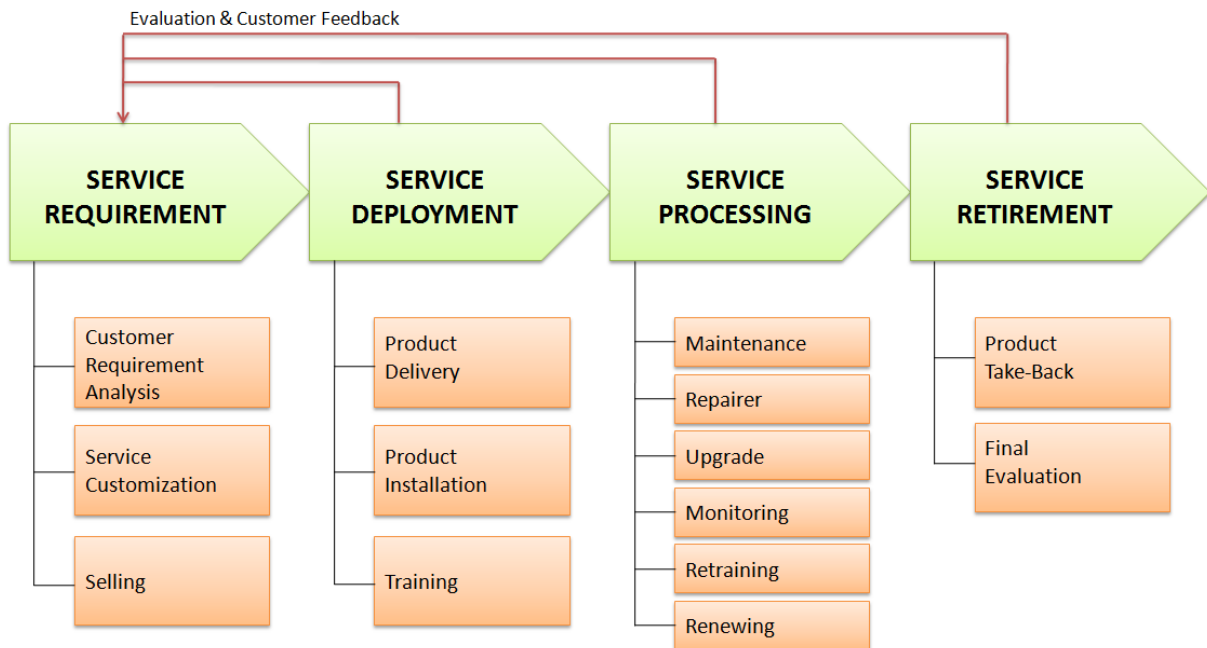

Figure 23 – Life-cycle model for Use-Oriented and Result-Oriented PSS. (Source: adapted from Lujing *et al.*, 2010).

This life-cycle model considers a great level of detail and it can be useful when designing the value proposition (Life-Cycle Value Proposition) regarding all the stages of the life-cycle. However, such a detailed analysis of the life-cycle may not be necessary for the value proposition, but may also be useful for the Value Configuration element. This framework can also be a guide for value creation and delivery.

References: Mien *et al.* (2005), Lujing *et al.* (2010).

6.2.12 Persona

The personas are archetypes built after a preceding exhaustive observation of the potential users. Each persona is based on a fictional character whose profile gathers up the features of an existing social group. In this way the personas assume the attributes of the groups they represent: from their social and demographic characteristics, to their own needs, desires, habits and cultural backgrounds.

It is an archetypical representation of real or potential users. It is not a description of a real, single user or an average user. The persona represents patterns of users' behaviour, goals and motives, compiled in a fictional description of a single individual. It also contains made-up personal details, in order to make the persona more "tangible and alive" for the development team.

The idea of personas originated from Alan Cooper (1999) and illustrates a model of a user that also should have a bit of personality; a life-like character driven by personal motives. According to Cooper, concepts as "user", "designed for the user" or "user-friendly" are too vague and therefore not practical to use as design models or definitions for the communication in the development team. With a blurred concept of "the user" it is easy to design for almost every possible feature. Instead, one should use a very specific individual – a persona – and direct the design for this individual. The reason for this approach is according to Cooper (1999): "*The more specific the persona is, the more effective they are as design tools. With more specific, idiosyncratic details, the persona becomes a "real" person in the minds of the developers.*"

The definition of persona given by Calde *et al.* (2002) is:*"User models, or personas, are fictional, detailed archetypical characters that represent distinct groupings of behaviours, goals and motivations observed and identified during the research phase."*

Though personas are not real people, they represent them throughout the design process. The fictional ingredient of personas, doesn't mean that they are just fantasies. Fictional details are added to make them more concrete and effective for design. For example, name, picture and some personal background details are made up (Cooper, 1999).

How to create personas

Ethnographic field studies and contextual inquiry are used in the early phases of the design in order to get data about the users. The result is a number of behavioural patterns. The pattern points to the users' goals and motives that is the desired effect of using the system. In business and technical domains, these patterns tend to map to professional roles. For consumer products they tend to correspond to lifestyle choices (Calde *et al.*, 2002).

In the next phase, several personas are created, based on the behavioural patterns and its associated goals. By creating a number of distinct personas, the whole range of behaviour is covered. Ideally, the behaviour of the personas should not overlap in order to keep the number of personas to a minimum. Each persona is elaborated in more detail. Goodwin

(2001) suggests that a description of persona should be captured in one to two pages consisting of goals, skills, attitudes, environment and a few fictional personal details to bring the persona to life. The number of personal details must be balanced.

Personas are design tools. The persona is unique for the domain and the design problem it was created for. As the persona is not a complete and general model of a user, it cannot be used in other domains or used later for new products (Goodwin, 2001).

Every project gets its own cast of characters, which consists of 3-12 unique personas. Not everyone is designed for, but they are all useful for articulating the user population. Some are even defined only to make it clear that we are not designing for them (a negative persona).

In the following example the aim of the project was to raise awareness of the BAA brand in the mind of the travellers. The first step of the design process was going to Heathrow Airport in order to speak directly with passengers and gathering information. The observation brought to the creation of personas describing some meaningful profiles and their experiences with BAA through a picture and a detailed text. Personas were used to create a framework based on those customer experiences, a framework that became the instrument for proposing service solutions. The propositions have been developed and illustrated and finally personas were used again to walk through the designed experiences and test them.
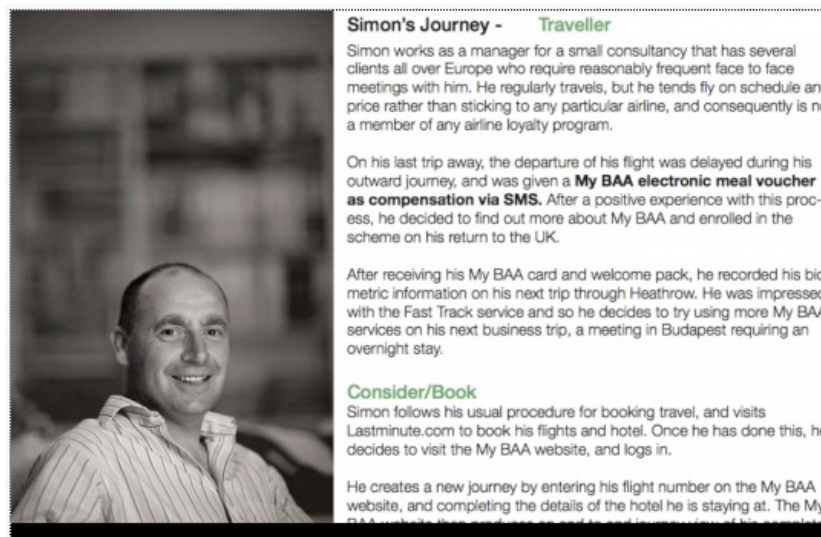

Figure 24 – Example of Persona.

Reference: http://www.servicedesigntools.org/tools/40 (24/07/2012) and Blomkvist (2002).

6.2.13 Product Life Gallery

A Product Life Gallery is a mapping tool to create a physical representation of the product's life-cycle. It is a good way to think, design and communicate in terms of life-cycle. This tool is as well a life-cycle support mechanism for product development teams. It is the product development team's collective memory and also an interesting visualisation of the environmental dispositions created.
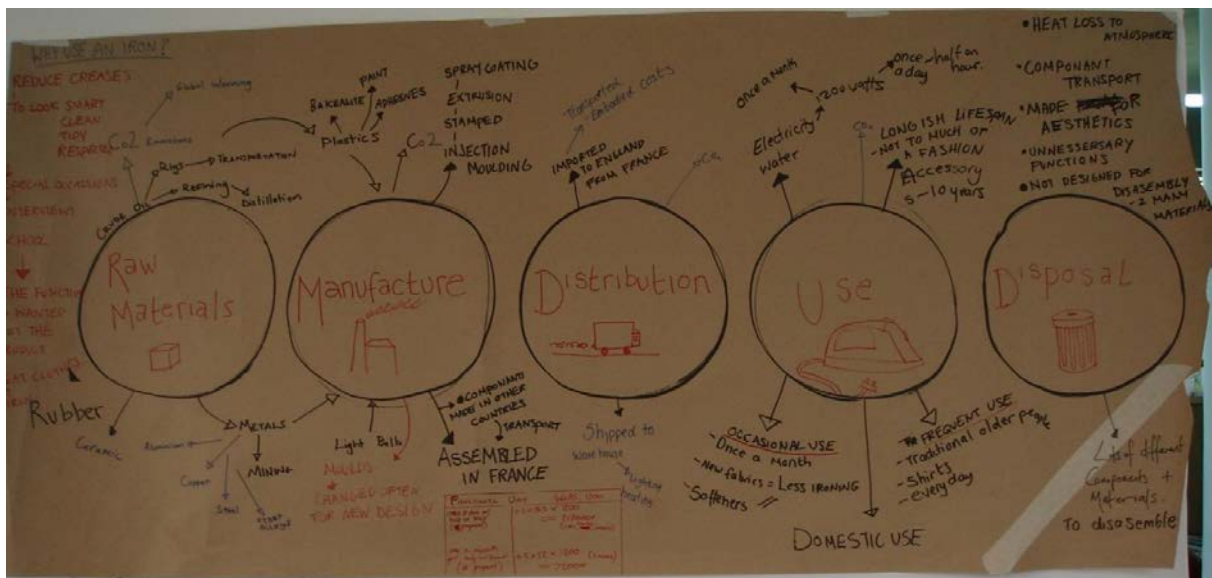
Reference: Material from the Technical University of Denmark – by Tim McAloone http://www.ipu.dk/upload/produktudvikling/innovation_update/baeredygtig_udvikling/methods.pdf (1/09/2012).

6.2.14 Scenario Planning

Among the many tools a manager can use for strategic planning, scenario planning stands out for its ability to capture a whole range of possibilities in rich detail. By identifying basic trends and uncertainties, a manager can construct a series of scenario that will help to compensate for the usual errors in decision making – overconfidence and tunnel vision.

Scenario planning simplifies the avalanche of data into a limited number of possible states. Each scenario tells a story of how various elements might interact under certain conditions. When relationships between elements can be formalized, a company can develop

quantitative tools. Although a scenario's boundary might at times be fuzzy; a detailed and realistic narrative can direct your attention to aspects you would otherwise overlook.

In short, scenario planning attempts to capture the richness and range of possibilities, stimulating decision makers to consider changes they would otherwise ignore. At the same time, it organizes those possibilities into narratives that are easier to grasp and use than great volumes of data. Above all, however, scenarios are aimed at challenging the prevailing mind-set.

Process for developing scenarios

1- Define the scope. The first step is to set the time frame and scope of analysis (in terms of products, markets, geographic areas, and technologies).

2- Identify the major stakeholders. Identify their current roles, interests, and power positions, and ask how they have changed over time and why.

3- Identify basic trends. What political, economic, social, technological, legal and industry trends are sure to affect the issues you identified in step one? Everyone participating in the process must agree that these trends will continue; any trend on which there is disagreement (within the time frame) belongs to the next step.

4- Identify key uncertainties. What events, whose outcomes are uncertain, will significantly affect the issues you are concerned with? For each uncertainty, determine possible outcomes. It is best to keep these outcomes simple, with a few possibilities at most. You may also want to identify relationships among these uncertainties, since not all combinations may occur.

5- Construct initial scenario themes. Once you identify trends and uncertainties, you have the main ingredients for scenario construction. A simple approach is to identify extreme worlds by putting all positive elements in one and all negative in another. (Note that positive or negative is defined here as relative to the current strategy. What seems to be negative scenario at first may later prove to be one of innovation and hidden opportunity). Alternatively, the various strings of possible outcomes (which jointly define a scenario) can be clustered around high versus low continuity, degree of preparedness, turmoil, and so on. Another method for finding some initial themes is to select the top two uncertainties and cross them. This technique makes the most sense if some uncertainties are clearly more important than others.

6- Check for consistency and plausibility. There are at least three tests of internal consistency dealing with the trends, the outcome combinations, and the reactions of major stakeholders. First, are the trends compatible with the chosen time frame? If not, remove the trends that do not fit. Second, do the scenarios combine outcomes

of uncertainties that indeed go together? For example, full employment and zero inflation do not go together. Third, are the major stakeholders placed in positions they do not like and can change? If so, your scenario will evolve into another one. Try to describe this end scenario, which is more stable. The stakeholder test is especially critical when building macro scenarios involving governments, international organizations (e.g., the International Monetary Fund, the United Nations) or strong interest group like OPEC.

7- Finally you must converge towards scenarios that you will eventually use to test your strategies and generate new ideas. Are these the scenarios you want to give others in the organization to spur their creativity or help them appreciate better the up-and-downside risks in various strategies? If yes, you are done. If not, repeat the steps and refocus your scenarios the way an artist judges the balance and focal point in a painting. Half of this judgment is art, half is science.

Reference: Schoemaker (1995).

6.2.15 Stakeholder Analysis

Subsequently, a tool to analyse stakeholders is presented. The key point and what makes it particular is its prioritization of the stakeholders. There are three main steps to follow:

1- **Identify your stakeholders:** the first step in your stakeholder analysis is to brainstorm who your stakeholders are. Possible stakeholders may be people who are affected by the company's work, people who have influence or power over it, or who have an interest in its successful or unsuccessful conclusion.

Table 16 – Possible stakeholders.

Your boss	Shareholders	Government
Senior executives	Alliance partners	Trades associations
Your coworkers	Suppliers	The press
Your team	Lenders	Interest groups
Customers	Analysts	The public
Prospective customers	Future recruits	The community
Your family		

It is important to point out that although stakeholders may be both organizations and people, ultimately communication is with people. Make sure that you identify the correct individual stakeholders within a stakeholder organization.

Figure 26 – Stakeholders' grid template.
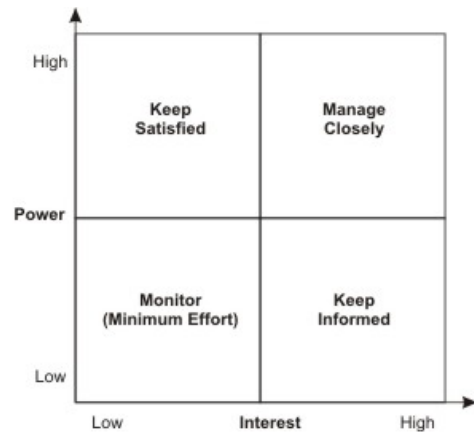
2- **Prioritize Your Stakeholders:** You may now have a long list of people and organizations that are affected by your work. Some of these may have the power either to block or advance. Some may be interested in what you are doing, others may not care. Map out your stakeholders on a Power/Interest Grid, and classify them by their power over your work and by their interest in your work.

For example, your boss is likely to have high power and influence over your projects and high interest. Your family may have high interest, but are unlikely to have power over it.

Someone's position on the grid shows you the actions you have to take with them:

- *High power, interested people*: these are the people you must fully engage and make the greatest efforts to satisfy.
- *High power, less interested people*: put enough work in with these people to keep them satisfied, but not so much that they become bored with your message.
- *Low power, interested people*: keep these people adequately informed, and talk to them to ensure that no major issues are arising. These people can often be very helpful with the detail of your project.
- *Low power, less interested people*: again, monitor these people, but do not bore them with excessive communication.

3- **Understand your key stakeholders:** You now need to know more about your key stakeholders. You need to know how they are likely to feel about and react to your project. You also need to know how best to engage them in your project and how best to communicate with them. Key questions that can help you understand your stakeholders are:

- What financial or emotional interest do they have in the outcome of your work? Is it positive or negative?

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- What motivates them most of all?

- What information do they want from you?

- How do they want to receive information from you? What is the best way of communicating your message to them?

- What is their current opinion of your work? Is it based on good information?

- Who influences their opinions generally, and who influences their opinion of you? Do some of these influencers therefore become important stakeholders in their own right?

- If they are not likely to be positive, what will win them around to support your project?

- If you do not think you will be able to win them around, how will you manage their opposition?

- Who else might be influenced by their opinions? Do these people become stakeholders in their own right?

A very good way of answering these questions is to talk to your stakeholders directly – people are often quite open about their views, and asking people's opinions is often the first step in building a successful relationship with them.

You can summarize the understanding you have gained on the stakeholder map, so that you can easily see which stakeholders are expected to be blockers or critics, and which stakeholders are likely to be advocates and supporters or your project. A good way of doing this is by colour coding: showing advocates and supporters in green, blockers and critics in red, and others who are neutral in orange.
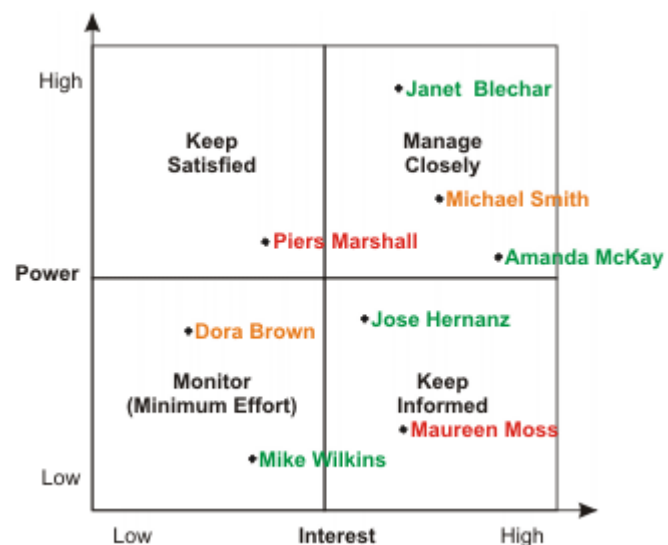

Figure 27 – Example of stakeholders' grid.

Reference: http://www.mindtools.com (21/05/2012).

6.2.16 SWOT Analysis

A SWOT analysis is tool to gain an understanding of the market positioning of the current offer and to conduct an identification of strengths, weaknesses, opportunities and threats of the company's business model.

It is a support to the development of the PSS. It should be used to ensure that the kind of offer under development builds on the strengths and opportunities of the company and that it resolves some of the threats and weaknesses. This tool requires participation of people with relevant knowledge of the company. The quality of the results obtained is dependent on the knowledge of the participants of the company's current strategy.

Fig. 28 displays a template for a SWOT analysis. Inside each box the list of strengths, weaknesses, opportunities or threats are written.

Figure 28 – Template for SWOT analysis.

Reference: www.mepss.nl (16/08/2012).

6.2.17 System platforms

Systemic solutions are the outcome of the collaboration between actors with different background, competences and cultures. Furthermore, especially in PSS, several factors are subjective and heavily dependent on individual behaviour, specific needs or technical conditions. The final output of a systemic interaction between the actors cannot be fixed in advance. When shifting from products to PSS, the final outcome of a design intervention is likely to consist of semi-finished solutions, rather than on finished material products.

This approach is not new to industrial production, which has introduced product platforms, in order to create families of products with the largest possible variation, given certain structural, material and technological settings. Product platforms support modular subdivision of products' components. Given a platform and a set of modular components, different architectures can be generated, in which the variation depends on the possibility to put together the components according to different combinations.

The logical structure of product platforms could also be used when dealing with systemic solutions. A platform for a systemic solution should put together different actors (service providers, manufacturers, institutional actors and final users) and describe each actor's competences, as well as the interactions (material and immaterial flows) which generate specific system architectures.

Platforms' representation does not have any fixed format, and thus icons and layout are variables that give the designer the possibility to emphasize certain aspects of the system.

Reference: Morelli *et al.* (2007).

6.2.18 Value Framework Model

The Value Framework Model provides a comprehensive integrated view on value, and it can be used to evaluate proposals for innovations at the different levels of value and from the different perspectives on value. The four levels of value are: (i) user, (ii) organization, (iii) ecosystem, and (iv) society. The perspectives on value are four social sciences: (i) economics, (ii) psychology, (iii) sociology, and (iv) ecology.

Figure 29 shows the four levels as concentric circles, each higher level encompassing the lower ones.

An innovation is considered valuable if it addresses the four levels from all four perspectives; in other words, when a positive check is made for all the items stated in the framework. For instance, an innovation is considered valuable for a user if it provides economic value through value for money; psychological value through happiness; sociological value through a sense of belonging; and ecological value by reducing the user's ecological footprint.
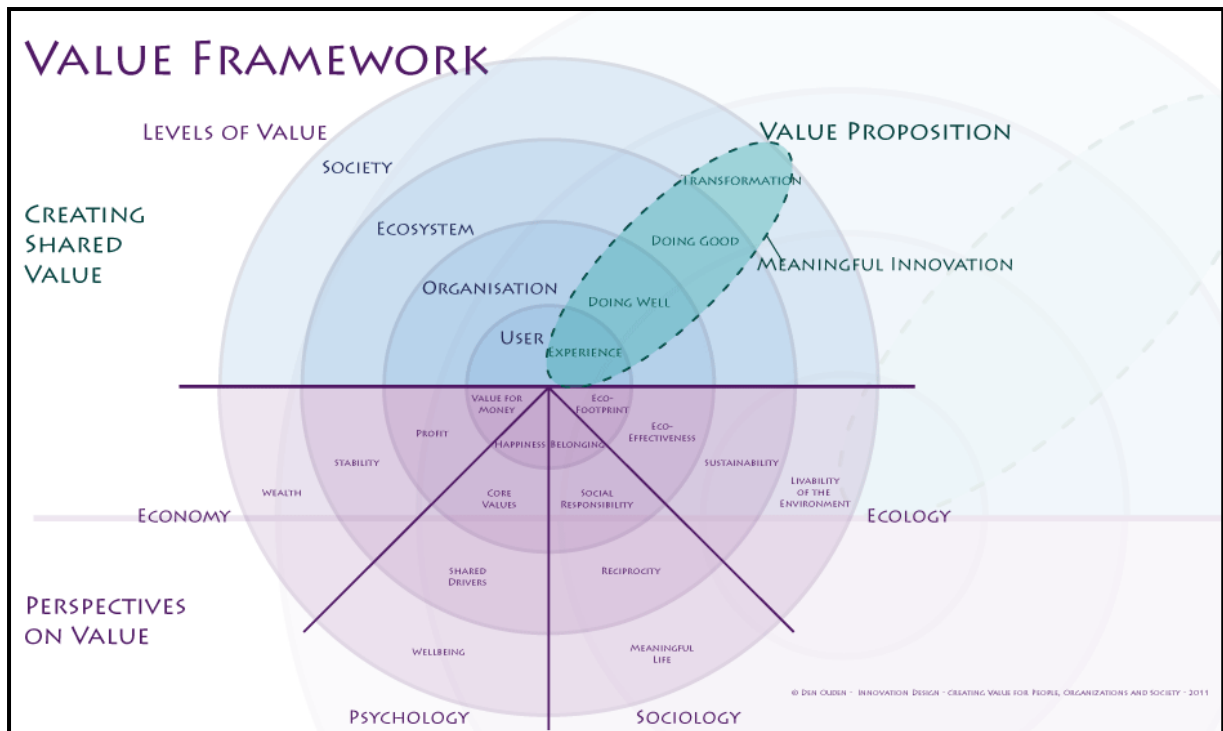
Figure 29 – The Value Framework model (Source: Den Ouden, 2011).

Reference: Den Ouden (2011).

6.2.19 Value Network Analysis

The Value Network Analysis diagram is a tool that maps the value exchange between the different actors of a business. This tool is based on Allee's three currencies of value presented in the literature review (3.4.4.2), so value exchanges can be (i) goods, services and revenue, (ii) knowledge, and (iii) intangible value. The goal is to map these value exchanges as a flow diagram. To be sure that nothing is overlooked it is best to consider each flow separately.
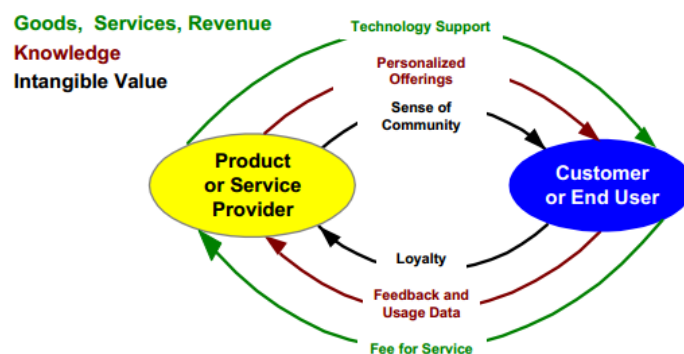

Figure 30 – Mapping the value exchanges.

There cannot be double-headed or unlabeled arrows in this analysis approach. Unlabeled or double-headed arrows are meaningless. Diagrammed this way, we know exactly who initiates the exchange, what specific value or product is being conveyed, and who receives it. With this level of detail, value creation can be analyzed from multiple perspectives such as time, goals, resources, results, costs, or value added by linking the diagram to analysis tables. It is also notable that the originators and recipients are real people or groups of people. In the rush to understand the wild and wooly world of e-commerce, people often confuse the mechanism with the exchange. New technologies are only pipelines for knowledge and value exchange. The exchange is what is really important.

Mapping the value network involves diagramming all three value exchanges with each and every member of the business or organizational network. The example in Fig. 31 is an e-commerce case. It shows how knowledge and intangibles can be leveraged in an Internet strategy. A clothing manufacturer moved into e-commerce through the mechanism of providing free marketing websites to its distributors. In this case, the manufacturer also allowed competing manufacturers to sell products via the same website.

But why a company would provide a marketing channel to their competitors? It only makes sense if we understand the flow of knowledge and intangible benefits that the manufacturer gains. The company gained usage data not only about sales of their own products, but also about these of their competitors. This very savvy company focused on the intangible benefits of building closer relationships with its end users and gaining market intelligence, customer feedback, and competitive intelligence. Knowledge value and intangible value in this case outweighed the financial return.

Figure 31 – Value Network Analysis diagram.

Reference: Allee (2000).

7. CONCLUSIONS AND FURTHER RESEARCH

As the last chapter of this work, the main conclusions and comments about the work done are presented.

Referring to literature review, not much previous research had been done on business models for Product-Service System, and the scope of this work has been somehow a novelty. Features of PSS have been compiled, to take into account all the issues that the business model had to refer to. Moreover, an extensive review of characteristics of business models has been done.

Attending to the state of the art, a concise and clear business model framework for PSS has been designed. All the PSS particular characteristics are reflected at one of the elements of the framework, but leaving enough freedom so that each company can design its own business model based on the BMF for PSS.

The framework has been designed according to the current trends of the issues, and above all, the framework has been given a very clear approach to sustainability, taking into account each of its three pillars – economic, social and environmental.

In reference to the tools for developing a real BM based on the BMF for PSS, a toolkit has been presented. It aims to be practical and easy to use, but there is a need of more tools in literature to properly develop some aspects of the BMF. For instance, some tools only help in the design process but do not really give clear steps for a methodical design.

Another issue to do more research on, is the definition of what a business model includes, and the establishment of precise boundaries between the concepts of business model, strategy and tactics; because there is lack of agreement between authors.

However, leaving aside the difficulties encountered, which are part of the research process, we can conclude that the result that has been reached is remarkably successful, and that the objectives initially set, have been properly achieved.

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  (7/07/2012)

ANNEX I – Summary table of Suspronet's methods & tools

Here, an overview of the methodologies and tools compiled by Suspronet (Suspronet, 2004) is introduced. They are presented in a table in order to have a synthetic view and a general perspective. These methodologies are not addressed to companies of a specific area; on the contrary, they have a general approach. The objective is not to give a complete description but to allow a comparison between methods.

The table allows comparison regarding the following aspects:

- The steps taken in the methodologies.
- How the methodology deals with cross-cutting issues of the PSS development process.
- The audience or target group.
- The purpose and results.
- The tools used; PSS specific tools in bold.

Table 17 – Suspronet's compilation of methodologies and tools.

Methodology	Steps in Methodology	How they deal with cross-cutting issues	Audience	Purpose/ result	Tools (PSS specific in Bold)
MEPSS	1. Analysis of company and market, 2. Idea generation identifying opportunities, 3. Detailed Design, 4. Implementation.	Matrix, which allows a lot of different ways through the methodology. Evaluation is cross cutting issue from simple to advanced (3 tier)	Designers and external consultants, and/or internal experts in companies. Needs facilitator and process promoter/ expert. Designer can take the role of external facilitator. Multidisciplinary teams+ external.	Sustainable solution to deliver satisfaction to the customer	Analysis: **3 tiers approach Sustainability/ cost assessment**, market assessment, **sustainability guidelines**, scenarios, **design plan** (including a lot of steps), **consumer acceptance analysis, system analysis and system maps**
ProSecCo	1. Initial phase: strategy development, external input, 2. Idea generation Opportunity development/ decide in economic terms, 3. Solution development: Offer/ organisational infrastructure, 4. Go–Decision Gate, Market launch, Exploitation.	Decision cluster: Check organisational capability, then suggest planning routine	First aiming at SMEs, but now for the informed interested company internal person. If this person is missing it needs external consultant/ process promoter. To support with expertise or knowledge sources (cases, data bases) that is not there internally. Depending on starting point of the company. Plus external support.	Improved capability of companies for PSS development. Concrete Result a new solution And/ or identification of knowledge and skills gap.	Workshop schemes, measuring corporate problems with specific steps, **assessment methodology, online co-operation tools, software or consulting tool,** customizing approach **Linking area of expertise with decision of problem areas in the process**
HiCS	1. Context of use/ analysis, 2. Partnership network, 3. Development of solutions/ Design.	Flexible system, learning by doing approach. Matrix for positioning of starting point and then plan a process	Big and small company, with small companies the facilitator was very important. With big companies the facilitator could be the initiator but the process can run on its own with a little bit of external support. Always needs a facilitator/ consultant. Multidisciplinary teams+ external.	Business plan, pilot case and final assessment. Prepare market launch	**Context of use analysis,** coordinating **partnership, design plan** (scenarios, user perspective, organisational perspective), **Benefit plan and validation at system level,** sustainability assessment **Solution Scan** (scan a company if it is capable of doing pss), **System map,** Interaction story board, **solution element brief,** stakeholder motivation matrix

Eco-efficient PSS – Factory of tomorrow	1. Analysis/ vision development, 2. Idea generation, 3. Evaluation and selection, 4. Marketing roadmap for PSS, 5. Implementation step leading to market launch, 6. Process evaluation.	A lot of complex Cross cutting issues Evaluation is cross cutting issue	Companies with Facilitators Especially for SMEs, really small 10-50 people. Integrate many stakeholders not just designers. Multidisciplinary teams + external	Business plan for new PSS offer, prepare market launch	**Workshop concept, case studies**, scenario, customer conferences, **need analysis**, creativity techniques, TRIZ, **INES**-evaluation, portfolios, **detailed checklist for implementation** issues including cross cutting issues, facilitation. **Design Manual**
DES methodology	1. Exploration, vision and business development, 2. Policy formulation, 3. Idea finding, 4. Strict PSS development, 5. Realisation	The methodology is not meant as a strict guideline on how eco-efficient PSS should be developed but to assist decision makers with a structure, suggested actions and tools. In that way the methodology is suitable for the broad variety of PSS.	Small, medium sized and big companies/ Networks	A detailed and feasible design of the new eco-efficient service that should result in a market introduction. The final phase 'evaluation' should guarantee a process of continuous improvement.	Market research tools, SWOT analysis, ViP scenario approach, Benchmarking, Backcasting, **Adapted ecodesign tools (e.g. META matrix, Adapted LiDS-wheel)**, Stakeholder analysis, Blueprinting', Ecocosts/value approach, Eco-purchase, LCA scenarios, 'Green' communication and Financial tools.
INNOPSE innovation studio methodology	1. Think it: scrutinising idea, benchmarking against company vision and strategies; 2. Tool it: integration of new idea into organisation and customers; 3. TRIZ it: problem solving stage; 4. Test it: testing and measurement. Practical steps for execution should be put in place and implemented.	?	Targets at Small Medium-sized Enterprises (that want incremental innovation assistance)	Idea development till 'idea execution and implementation/ testing phase'.	Balanced scorecards (BSC), brainstorming and mind mapping. Affinity diagram, the analytical hierarchy process and Quality function Deployment (QFD). TRIZ methodology (i.e. Contradiction table, the 40 inventive principle, ARIZ, 76 standard solutions, separation principles, Patterns of evolution, substance field analysis).
BISS methodology	1. Definition of current business model, 2. Mapping out interests of all involved actors, 3. Making a chart of economical and ecological inefficiencies, 4. Generation of new PSS, 5. Definition of the new business model and the key contracts. Also testing.	The point of origin is that it is possible to construct business models in such a way that the created PSSs inherently induce sustainability. Methodology is open for P, S and PSS solutions.	Small, medium sized and big companies/ Networks	The methodology focuses on de-linking mechanisms. The end result should be definition and testing of a sustainable business model.	**System map**, inefficiencies charts.

Kathalys method	1. Exploratory research and definition, 2. Design, 3. Product/service specification, 4. Elaboration and practical experimentation, 5. Implementation.	...	Small, medium sized and big companies/ Networks	An up and running Product/Service: a fully developed PSS with environmental/economical benefits.	Problem analysis, interviews, Shell-scenario method, workshops, ViP-method, Delphi, SWOT, roadmaps, LCA, Eco-indicator,
PSS Innovation Scan for Industry (TNO/PwC; Tukker and van Halen, 2003)	0. Preparation of the PSS Innovation scan, 1. Introduction of PSS, 2. Analyse phase, 3. Idea generation, 4. Selection, 5. Management presentation.	...	Small, medium sized and big companies/ Networks. The scan has been written for experts working in the R&D departments or business developers of industries and for consultants.	The aim of this scan is to formulate a first business case for PSS that gains management commitment for a feasibility study.	Most of the tools are general development tools. Some are especially aimed at integrating environmental issues, e.g. Eco-design portfolio, Pragmatic Differential tool, Progressive abstraction tool.
The PSS Innovation workbook (James et al.)	No process steps but focussing on answering these questions: 1. What could you potentially offer as eco-efficient services? 2. What eco-efficient services might customers pay for? 3. What specific eco-efficient services could you actually offer?	James et al. Do not suggest a new process step logic but give support to ask the right questions and think about the right issues during product-service-development.	The study focussed especially on the electronics and IT sector.	The aim is to condense the broad insights generated in the development process into a specific list of possible options from which the most promising can be selected for more detailed consideration during the final stages of the development process.	Workshops, brainstorming
Sustainable Homeservices	1. Analysis of the housing-situation, 2. Visualising/categorising the universe of homeservices, 3. Questionnaires to the residents, 4. Questionnaires to external service providers and housing organisations, 5. Applying a sustainability evaluation tool, 6. Locate opportunities for new homeservices and define the possible roles of the actors.	The project recognizes that not every product can be replaced by a homeservice. Residents' demands, organisational and economical aspects of the suppliers and intermediaries need to be taken into account.	The principle target groups of the project are residents, intermediaries, such as the housing organisations, and the service providers.	Stimulate the introduction of sustainable homeservices in Europe	Questionnaires, sustainability evaluation tool, workshops

Sustainable Product and Service Development (SPSD) approach	The steps in the guide are based on ISO14062; 1. Planning, 2. Offering development: • Concept development, • Detailed design, • Testing/prototype, • Offering launch and marketing, • Offering review.	The format is open so that the process can be customised to offering, sector, company(ies) culture and business systems. The SPSD approach aims at developing 'innovative offerings'; that can be services, products and PSS.	SMEs? The SPSD approach was tested with 59 companies.	Aims at developing 'innovative offerings' (e.g. services, products, PSS) that are sustainable, achieve the required functionality, meet human needs (or: end-user requirements) and are cost effective.	Strategies checklist (environmental and social), simplified LCA and environmental product declarations
PSS methodology – Aalborg University	1. Identifying the actors in the network; 2. Envisioning possible PSS scenarios, 3. Representing the structure of PSS.	...	Architecture and Design education; students	PSS development methodology for design education.	**System maps**, analytical frameworks, scenarios and use cases, IDEF0, **Use Case Scenarios** and **Representation techniques**. These tools and methods are not new but are adapted to PSS development.