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Chapter 3

Sustainable Product-Service System (S.PSS)



3.1 S.PSS: An Introduction and Definition

A key contemporary query is the following: within the current social, environmental and economic crisis, which are the opportunities for innovate towards sustainability? Do we know any offer/business model capable of creating (new) value, decoupling it from material and energy consumption? In other words, is there any alternative to significantly reduce the environmental impact of traditional production/consumption systems?

One promising alternative is the development and implementation of sustainable product-service systems, which can be defined as an *'...offer model providing an integrated mix of products and services that are together able to fulfil a particular customer demand (to deliver a "unit of satisfaction"), based on innovative interactions between the stakeholders of the value production system (satisfaction system), where the ownership of the product/s and/or its life cycle responsibilities remain by the provider/s, so that the economic interest of the providers continuously seek new environmentally and/or socioethically beneficial solutions'* (adapted from Vezzoli et al. [22]).

Sustainable Product-Service System (S.PSS) has been studied since the end of the 90s as (one of) the most promising offer/business models in this perspective [3, 4, 8, 9, 12, 16, 24]. More recently, they demonstrate to be one of the most promising offer models to extend the access to goods and services even to low- and middle-income contexts, thus enhancing social equity and cohesion. S.PSS is understood as a win-win offer model combining the three pillars of sustainability, the economic with the environmental and the socioethical ones.

In fact, Sustainable Product-Service System (S.PSS) is value propositions introducing relevant innovation on different levels (see even Fig. 3.1).

- They shift the business focus from selling (only) products to offering a so-called 'unit of satisfaction', i.e. a combination of products and services jointly capable of achieving a final user satisfaction;

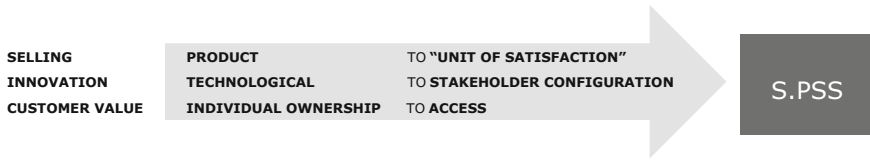


Fig. 3.1 S.PSS: a paradigm shift from traditional product offer. *Source* designed by the Authors

- They shift the primary innovation from a technological one to an innovation on a stakeholder interaction level, i.e. they are based on three main types of innovative stakeholder configurations: product offer combined with product life cycle services to customer, offer as enabling platform for customers and final results offer to customers;
- They shift the value perceived by the customer from individual ownership to access to goods and services.

Finally, as the key understanding of our discourse, S.PSSs are offer models with a win-win sustainability potential, i.e. they are offer/business models capable of creating (new) value decoupling it from resources consumption and environmental impact increase while extending access to goods and services to low- and middle-income people enhancing social equity and cohesion.

3.2 S.PSS Types

There is a continuum of approaches for an S.PSS configuration on which it is possible to identify three major S.PSS types to system innovation, which have been studied and listed as favourable to achieve higher levels of eco-efficiency [19, 21, 22].

1. Product-oriented S.PSS: services providing added value to the product life cycle;
2. Use-oriented S.PSS: services providing ‘enabling platforms for customers’;
3. Result-oriented S.PSS: services providing ‘final results’ for customers.

3.2.1 *Product-Oriented S.PSS: Adding Value to the Product Life Cycle (Type I)*

Let us start with an example of an eco-efficient system innovation adding value to the product life cycle.

Wilkhahn aftersale services for chairs.

During office swivel chairs life, periodical checks are carried out to keep the products in good working order. The order includes a service agreement which comprises three visits by service technicians within a period of 5 years. Older products, which no longer meet current technical or design standards, may be updated if the customer wishes. The customer can find the information about these opportunities on the product web-site. At the end of product life customers are offered take-back and recycling services. For furniture ranges, that are no longer produced, an additional repair service for two years is offered. A general overhaul is usually carried out at producer's plant based on a detailed estimate, and is arranged by the company consultant or by a local dealer. The producer company, guarantees the take-back of worn out products. They are disassembled, all parts are sorted into pure material categories and passed on for recycling. In the case of a new order, no take-back costs will be billed for those chairs being replaced by new chairs ordered from Wilkhahn. Wilkhahn interests do not rely only on the number of chairs sold, but also on service; in fact, the services provided help to reduce the number of products to be entirely replaced. Clients perceive added value from the offered services because they free them from the costs and the problems associated with the monitoring and checking of their chairs. Achieving better efficiency from chairs and chair-services also provides many economic benefits both in production processes and in improving the life of chairs.

A **product-oriented S.PSS** innovation adding value to the product life cycle is defined as follows:

A company (alliance of companies) that provides additional services to guarantee an extended life cycle performance of the product/semi-finished product (sold to the customer).

A typical service contract would include maintenance, repair, upgrading, substitution and product take-back services over a specified period.

This reduces the user's responsibility in the use and/or disposal of the product/semi-finished product (owned by her/him), and the innovative interaction between the company and the customer drives the company's economic and competitive interest in continuously seeking environmentally beneficial new solutions, i.e. the economic interest becomes something other than only selling a larger number of products.

3.2.2 Use-Oriented S.PSS: Offering Enabling Platforms for Customers (Type II)

The following box describes an example of an eco-efficient S.PSS innovation as an enabling platform for customers.

Car sharing—Move About by Th!nk

Move About, like many other car-sharing systems, is a service providing an enabling platform of product (car) and services. It is a car-sharing scheme for the general public in Oslo; the fleet of vehicles is made up of 40 electric cars, all from the Norwegian manufacturer Th!nk. Users pay a monthly membership fee plus an hourly rate (including everything from the insurance to the energy to move the vehicle). For car users, a subscription to a car-sharing system provides convenient access to car mobility at lower costs than a traditional car rental agency. The local administration offers various incentives, such

as free parking, exemption from road pricing and authorization to drive in bus lanes.¹ A car-sharing system intensifies the use of cars, meaning a lower number of cars are needed in a given context for a given demand for mobility.

A **use-oriented S.PSS** innovation offering as an enabling platform to customers is defined as follows:

A company (alliance of companies) offering access to products, tools, opportunities or capabilities that enable customers to meet the particular satisfaction they want (in other words efficiently satisfying a particular need and/or desire). The customer obtains the desired utility but does not own the product that provides it and pays only for the time the product is actually used.

Depending on the contract agreement, the user could have the right to hold the product/s for a given period of time (several continuous uses) or only for one use. Commercial structures for providing such services include leasing, pooling or sharing of certain goods for a specific use.

The client thus does not own the products and does operate them to obtain the final satisfaction (the client pays the company to provide the agreed results). Again, in this case, the innovative interaction between the company and the client drives the company's economic and competitive interest to continuously seek environmentally beneficial new solutions, e.g. to design highly efficient, long-lasting, reusable and recyclable products.

3.2.3 *Result-Oriented S.PSS: Offering Final Results to Customers (Type III)*

The following describes an example of an eco-efficient S.PSS innovation providing final results to customers.

Phillips, pay per lux service.

The 'pay per lux' is a full-service providing a final result, consisting of 'selling' light as a finished product. Light is delivered through a led system, which is produced and managed during its life by Phillips. Business customers pay a regular fee to Phillips that covers their entire lighting service – design, equipment, installation, maintenance and upgrades – only paying the 'lux', the light consumed. The innovation of this product-service system is that Phillips will not invoice the client for the energy consumed to obtain the 'lux', but rather, 'lux' is sold as an entire service. By planning for longevity rather than a with a product-sale approach, it provides the most efficient and cheapest lighting possible, thus encouraging the uptake of energy-saving lighting. At the end of the contract, products can be returned to the production process again, reusing the raw materials, optimising recycling and reducing waste.

¹See www.mindsinmotion.net/index.php/mimv34/themes/hybrid_electric/featured/move_about.

A **result-oriented S.PSS innovation** offering final results to customers can be defined as follows:

A company (alliance of companies) that provides a customised mix of services (as a substitute for the purchase and use of products), in order to provide an integrated solution to meet a particular customer's satisfaction (in other words a specific final result). The mix of services does not require the client to assume (full) responsibility for the acquisition of the product involved. Thus, the producer maintains the ownership of the products and is paid by the client only for providing the agreed results.

The customer does not own the products and does not operate them to achieve the final satisfaction; the client pays the company to provide the agreed results. The customer benefits by being freed from the problems and costs involved in the acquisition, use and maintenance of equipment and products. The innovative interaction between the company and the client drives the company's economic and competitive interest to continuously seek environmentally beneficial new solutions, e.g. long-lasting, reusable and recyclable products.

Moreover, if properly conceived, S.PSS can offer to low- and middle-income people the opportunity to get access to services that traditional product sales models would not allow.

In fact, it has been argued that in low- and middle-income contexts 'a S.PSS innovation may act as a business opportunity to facilitate the process of a socio-economic development by jumping over the stage characterised by individual consumption/ownership of mass-produced goods—towards a 'satisfaction-based' and 'low resource-intensity' advanced service-economy' [20].

3.3 S.PSS Sustainability Benefits

The next paragraphs describe in detail the sustainability win-win potentials of S.PSS models in terms of environmental, socioethical and economic benefits.

3.3.1 S.PSS Environmental Benefits

When is an S.PSS eco-efficient? When can we decouple the economic interests from resource consumption and environmental impact in general? In other terms, why and when is an S.PSS producer/provider economically interested in design for environmental sustainability?

The following S.PSS environmental benefits (eco-efficient potentials) could be highlighted.

- (a) As far as the S.PSS model is offering the products/s, retaining the ownership and being paid per unit of satisfaction, or offering all-inclusive the product with its maintenance, repair and substitution, the LONGER the product/s or its

components last (*environmental benefits*), the MORE the producer/provider avoids/postpones the disposal costs plus the costs of pre-production, production and distribution of a new product substituting the one disposed of (*economic benefits*). Hence, the producer/provider is driven by economic interests to **design (offer) for lifespan extension of product/s** (*eco-efficient product LCD implications*).

- (b) As far as the S.PSS model is selling a shared use of product/s (or some product's components) to various users, the MORE intensively the product/s (or some product's components) are used, i.e. being used most of the time (*environmental benefits*), the HIGHER the profit, i.e. proportionally to the overall use time (*economic benefits*). Hence, the producer/provider is driven by economic interests to **design for intensive use of product/s** (*eco-efficient product LCD implications*).
- (c) As far as the S.PSS model is selling all-inclusive the access to products/s and the resources it consumes in the use phase, with payment based on unit of satisfaction (product's ownership by the producer/provider), the HIGHER the product/s resource efficiency in the use phase (*environmental benefits*), the HIGHER the profit, i.e. the payment minus (among others) the costs of resources (*economic benefits*). Hence, the producer/provider is driven by economic interests to **design/offer product/s that minimise resources consumption in the use phase** (*eco-efficient product LCD implications*).
- (d) As far as the S.PSS model is selling energy as all-inclusive access to the energy production unit and the source for energy generation, with pay per period/time/satisfaction (energy production unit ownership by the producer/supplier), the HIGHER the use of passive/renewable sources of energy (*environmental benefits*), the HIGHER the profit, i.e. the payment minus (among others) the costs of non-passive/renewable sources of energy supplied (*economic benefits*). Hence, the producer/provider is driven by economic interests to **design (offer) for passive/renewable resources optimization** (*eco-efficient product LCD implications*).
- (e) As far as the S.PSS model is selling all-inclusive the product with its end-of-life treatment/s, the MORE the materials are either recycled, incinerated with energy recovery, or composted (*environmental benefits*), the MORE are the avoided costs of landfilling and new primary material, energy or compost (*economic benefits*). Hence, the producer/provider is driven by economic interests to **design for material life extension (recycling, energy recovery or composting)** (*eco-efficient product LCD implications*).
- (f) As far as the S.PSS model is selling all-inclusive the toxic or harmful product/s with use and/or end-of-life toxicity/harmfulness management services, the LOWER the potential toxic or harmful emissions during use and/or at the end-of-life (*environmental benefits*), the MORE the avoided costs of both toxic/harmful treatments in use and/or at the end-of-life. Hence, the producer/provider is driven by economic interests to **design (offer) for toxicity/harmfulness minimization** (*eco-efficient product LCD implications*).

To conclude, when is an S.PSS eco-efficient? When the product ownership and/or the economic responsibility of its life cycle performance remains by the producer/providers who are selling a unit of satisfaction rather than (only) the product.

And why does this happen? Because this way, we shift/allocate responsibility for the products and/or the services design/development, to the producers/providers, that in this way has direct economic and competitive interest in reducing the environmental impacts of their products/services.

Finally, within an S.PSS model, a product LCD/eco-design is eco-efficient. In other terms, an S.PSS producer/provider is economically interested in design for:

- Product lifespan extension and use intensification;
- Material life extension (recycling, energy recovery, composting);
- Resource (materials and energy) minimisation;
- Resource (materials and energy) renewability and biocompatibility;
- Resource (materials and energy) toxicity/harmfulness minimisation.

3.3.2 S.PSS Socioethical Benefits

Why S.PSS may foster socioethical benefits? Because S.PSS make goods and services accessible to both final users and entrepreneurs even in low- and middle-income contexts. The following S.PSS socioethical benefits (social equity and cohesion potentials) could be highlighted.

- (a) As far as the S.PSS model is selling the access rather than mere product ownership, this reduces/avoids purchasing costs of products which are frequently too high for low- and middle-income people (*economic benefits*), i.e. making goods and services more easily accessible (*socioethical benefits*).
- (b) As far as the S.PSS model is selling the ‘unit of satisfaction’ including life cycle services costs, this reduces/avoids running cost for maintenance, repair, upgrade, etc. too high for low- and middle-income people (*economic benefits*), i.e. avoiding interruption of product use (*socioethical benefits*).
- (c) As far as the S.PSS model is selling access rather than working equipment, this reduces/avoids initial (capital) investment costs of equipment, frequently too high for low- and middle-income entrepreneurs (*economic benefits*), i.e. facilitating new business start-up in low- and middle-income contexts (*socioethical benefits*).
- (d) As far as the S.PSS model is selling entrepreneurs all-inclusive life cycle services with the equipment offer, this reduces/avoids running cost for equipment maintenance, repair, upgrade, etc. frequently too high for low- and middle-income entrepreneurs (*economic benefits*), i.e. this avoids interruption of equipment use (working activities) (*socioethical benefits*).
- (e) As far as the S.PSS model is offering goods and services without purchasing costs, this opens new market opportunities for local entrepreneurs via new potential low- and middle-income customers (BoP), i.e. potentially empowering locally based economies and improving quality of life (*socioethical benefits*).

3.3.3 S.PSS Economic and Competitive Benefits

What are the main economic and competitive benefits of S.PSS? The following S.PSS economic and competitive benefits could be highlighted:

- (a) As far as the S.PSS model offer service along all its life cycle, they can establish longer and stronger relationships with customers, i.e. increasing customer fidelity.
- (b) As far as the S.PSS model is different from traditional product sales which are nowadays in saturated market, they can open up new business opportunities, i.e. empowering strategic positioning.

3.4 S.PSS Barriers and Limits

3.4.1 Not All PSSs Are Sustainable

It is important to underline that not all shifts to PSS result in environmental benefits: a PSS must be specifically designed, developed and delivered, if it is to be highly eco-efficient. For example, schemes where products are borrowed and returned incur transportation costs (and the resultant use of fuel as well as polluting emissions) over the life of the product. In some specific instances, the total fuel cost and environmental impact may make the system non-viable in the long term.

Furthermore, even when well designed, it has been observed that some PSS changes could generate unwanted side effects, usually referred to as rebound effects.

Society is a set of complexes, interrelated systems that are not clearly understood. As a result, something may happen that turns potential environmentally sound solutions into an increase in global consumption of environmental resources at the practical level. One example is the impact of PSS on consumer behaviour. For example, outsourcing, rather than ownership of products, could lead to careless (less ecological) behaviours.

Nevertheless, S.PSS development seen presents great potential for generating win-win solutions that promote profit and environmental benefits. It has the potential to provide the necessary, if not sufficient, conditions to enable communities to leapfrog to less resource-intensive (more dematerialised) systems of social and economic systems.

3.4.2 Barriers

Barriers to overcome may include a lack of external infrastructure and technologies, e.g. for product collection, remanufacturing or recycling. Per stakeholder type, barriers for the eco-efficient PSS diffusion in industrialised contexts are summarised as follows [5, 6]:

- For **companies**, the adoption of an S.PSS strategy is more complex to be managed than the existing way of delivering products alone. There is a need to implement changes in corporate culture and organisation to support a more systemic innovation and service-oriented business [20]; there is indeed resistance by companies to extend involvement with a product beyond point-of-sale [14, 18]. Extended involvement requires new design and management knowledge and approaches. It requires medium-to-long-term investments and is therefore connected with uncertainties about cash flows [16]. Moreover, a further obstacle is the difficulty of quantifying the savings arising from S.PSS in economic and environmental terms, in order to market the innovation to stakeholders both inside and outside the company, or to the company's strategic partners [20]. Finally, the significant change in the system of earning profit could deter producers from employing the concept, first through limited experience in pricing such an offering, and second through fear of absorbing risks that were previously assumed by customers [1];
- For **customers/users**, the main barrier is the cultural shift necessary to value an ownerless way of having a satisfaction fulfilled, as opposed to owning a product [10, 13, 14, 20]. Solutions based on sharing and access contradict the dominant and well-established norm of ownership [2]; this is especially true in the B2C market, while in the B2B sector numerous examples of eco-efficient PSS concepts can be identified [17]. Product ownership not only provides a function to private users but also status, image and a sense of control [11]. Another obstacle is the lack of knowledge about life cycle costs [23], which makes it difficult for a user to understand the economic advantages of ownerless solutions;
- For **governments**, on the regulatory and policy side, actual laws may not favour S.PSS-oriented solutions. Environmental innovation is often not rewarded at the company level due to lack of internalisation of environmental impacts [15]. In addition, there are difficulties in implementing policies to create corporate drivers to facilitate the promotion and diffusion of this kind of innovation [7, 15].

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