

# A suggestion for research on PSS development to improve sustainability and consumer satisfaction: influencing consumers approach

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**Abstract:** Product Service Systems(PSS) are known as sustainable business models that directly fulfill client demands and decrease material consumptions with a combined set of products and services. Services such as information, knowledge, experience, knowhow, time, images, and stories are immaterial and intangible. Therefore companies can get profits by less material consumption, as serving services with products instead of the existed product sales models. However, despite PSS's original concept and goal, some studies have indicated that majority of PSS cases are generally not sustainable. Possible reasons for this failure can be find in companies and consumers both. The purpose of this paper is to investigate the failure reasons more significantly in the consumer aspects and suggest the plan of future study that can improve sustainability with consumers' satisfaction by influencing consumers.

**Key words:** *Product-Service System, sustainability, influencing behaviors, customer values, design framework*

## 1. Background and Purpose

### 1.1 Concept and competitiveness of PSS

The concept of PSS is not new but also the compatibility in the market has apparently known through the related success cases. The basic idea of PSS is not to sell the product itself, but rather the service, which is offered by the product. It is known that consumers are interested in this service and not so much in the product itself.<sup>1</sup> Since highly customized and contextualized combination of products and services can be met customers demands more deliberately, companies can gain profits. There most PSS models are designed to investigate and fulfill customer demands. But several PSS cases have still not been implemented widely in the aspect of sustainability.

### 1.2 Sustainability: Product sales model, PSS and sustainable PSS

As above, customer satisfaction is the a primary competitiveness in implementing PSS but sustainability is a secondary or sometimes not considered. However, while services tend to be less material and energy than manufactured goods, the service transition has not reduced absolute material and energy throughput in the economy. Because the service economy depends fundamentally on the industrial economy. For example, some

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<sup>1</sup> Ines Omann (2003) *Product Service Systems and their Impacts on Sustainable Development*

service providers should generate the environmental impacts when they move using transportations and offer services consuming some supplies(products). It can be also confirmed where service category cases Korea's carbon footprint labelling. The carbon footprint in service category can be converted from the amount of input and output data while those service offers. For example, if one person stays a hotel room for 1 night, he will consume energy, water, products and disposable products such as comb, toothbrush, some beverages and so on. The environmental impacts from those consumption are converted to the hotel service's carbon footprint. Therefore if the hotel offers more services according to customer demands or service quality, the environmental impacts will be increased generally.

Different approach on PSS's sustainability, it is presented among the definitions. Several researchers including Kang(2009) demonstrated the definition between PSS and sustainable PSS separately. To explain the correlation between sustainability and three types of business models - product sales model, PSS model, sustainable PSS model -, related definitions are investigated and rearranged in the aspects of sustainable effectiveness [Table 1].

Table 1. Correlation between sustainability and three types of business models

Classification	Definition	Sustainability
Product sales model	<ul style="list-style-type: none"> <li>• In the case of the typical product sales model, producing and selling products is the primary method to meet client demands, regardless of the type of actual demands. Companies could sustain their business by developing new products, increasing production and sales volume</li> </ul>	<ul style="list-style-type: none"> <li>● <b>Unsustainable</b></li> <li>● Customer Satisfaction by tangible Products</li> <li>● More Material production &amp; consumption</li> <li>● More Environmental impact</li> </ul>
PSS model	<ul style="list-style-type: none"> <li>• Services and service mediated innovation processes intertwining services and industrial products.” (Bilderbeek &amp; Den Hertog, 1997)</li> <li>• A Product Service system (PS system) is a marketable set of products and services capable of jointly fulfilling a user’s need.” (Goedkoop et al., 1999:18)</li> <li>• A differentiated system that tangible product and intangible service, which secure higher competitive edge than existing business model and provide users effectiveness during product life cycle, were combined (Ah-Reum Park et al., 2011)</li> </ul>	
Sustainable PSS model	<ul style="list-style-type: none"> <li>• Eco efficient services are systems of products and services which are developed to cause a minimum environmental impact with a maximum added value.” (Brezet et al., 2001a:8)</li> <li>• A Product Service System can be defined as the result of an innovation strategy, shifting the business focus from designing and selling physical products only, to selling a</li> </ul>	

	<p>system of products and services which are jointly capable of fulfilling specific client demands.” (Manzini &amp; Vezzoli, 2002)</p> <ul style="list-style-type: none"> <li>• A system of products, services, supporting networks and infrastructure that is designed to be competitive, satisfy customer needs and have a lower environmental impact than traditional business models.” (Mont, 2002)</li> <li>• Sustainable PSS are system solutions that provide consumers with both functional and nonfunctional values which increase their satisfaction, yet consuming less material and energy.” (Wimmer et al., 2007)</li> </ul>	<ul style="list-style-type: none"> <li>• Customer Satisfaction by Intangible Services</li> <li>• Less material production and consumption</li> <li>• Less Environmental Impact</li> </ul>
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Above definitions on sustainable PSS are fairly general and known well, and the sustainable aspect is still important. But PSS concept and terminology have been conceived from Academic Industrial Sustainability Community, but industrial organizations are not still correctly informed about them. (Nicola P. Bianchi et al., 2009) Even some companies adopt PSS due to the differentiation strategy that can survive in the saturation market based on product manufacturing. Those companies ignore the sustainability aspects in PSS. In a conventional products models, companies try to more new products with material and energy consumption to gain profits.

In a PSS models, however, the strategy is to provide a customer with an access to products and sell their functions as well as additional labour and knowledge instead of ownership. Most PSS solutions, therefore, do not necessarily produce and sell a new product. Instead, an efficient and effective combination of products, labour, and knowledge allows the company to gain profit and save material consumption, while serving client demands equally well as, or even better than a product sales model.<sup>2</sup> Mostly PSS includes product maintenance, parts recycling and eventual product replacement, which satisfy customer needs competitively and with lower environmental impact over the life cycle. Summarizing PSS is, today, mainly a prescriptive improvement strategy, focusing on adding sustainable value.

## 2. Barriers to PSS' sustainability improvement in the aspects of consumers

In a PSS model, more demands can be met with lower material and energy requirements by using a service to meet customer demands rather than a physical object. However, while services tend to be less material and energy than manufactured goods, the service transition has not reduced absolute material and energy throughput in the economy. Because the service economy depends fundamentally on the industrial economy.

For example, some service providers should generate the environmental impacts when they move using transportations and offer services consuming some supplies(products). It can be also confirmed where service category cases in Korea's carbon footprint labelling. The carbon footprint in service category can be converted

<sup>2</sup> KANG, MYUNG-JOO (2009) Development of Sustainable and Competitive Product Service System Solutions: Verification and Improvement of Methods and Tools, TU WIEN, p 10

from the amount of input and output data while those service offers. For example, if one person stay a hotel delux room for 1 night, he will consume energy, water, products and disposable products such as comb, toothbrush, some beverages and so on[Figure 1]. The environmental impacts from those consumption are converted to the hotel service's carbon footprint. Therefore if the hotel offers more services according to customer demands or service quality, the environmental impacts will be increased generally.

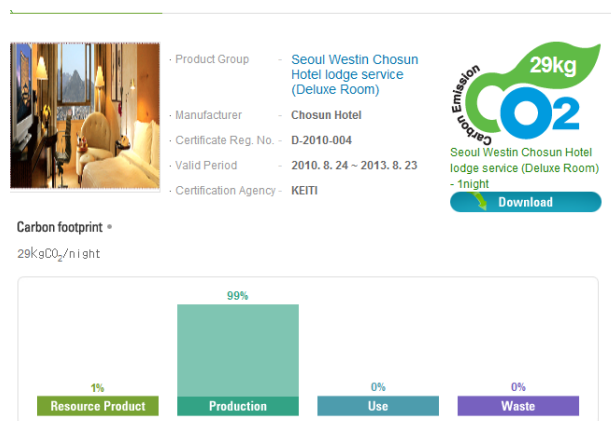


Figure 1. The service category case in Korea's Carbon footprint labelling  
 \_ Seoul Westin Chosun Hotel lodge service (Deluxe Room)

The barriers of PSS have been discussed in related organizations' literatures [Table 2]. It has been said that not all shifts to PSS result in environmental benefits. Therefore companies must design, develop and deliver PSS models to be highly eco-efficient. But sometimes, even well-designed PSS may generate unwanted side effects, usually referred as rebound effects. It is also related to consumer aspects, either. For example, outsourcing, rather than ownership of products, could lead to consumers' unsustainable behaviors.

Table 2. Barriers of sustainable PSS

organization	Barriers of sustainable PSS
UNEP	<p>Business include lack of knowledge and experience in terms of:</p> <ul style="list-style-type: none"> <li>▪ service design methods and tools</li> <li>▪ new tools, which companies can use to assess and implement PSS</li> <li>▪ service management systems</li> <li>▪ entrepreneurial personnel who are skilled in service development and provision, and life-cycle costing methods.</li> </ul>
	<p>Furthermore, businesses may perceive the risks of:</p> <ul style="list-style-type: none"> <li>▪ conflict with existing internal procedures and tools, e.g. accounting and reporting methods</li> <li>▪ service being easily replicated by a competitor (more easily than a physical product)</li> <li>▪ partnerships and entrepreneurial interdependence leading to reduced control of core competencies and reducing the influence of business decisions.</li> </ul>

EU EPA <sup>3</sup>	<ul style="list-style-type: none"> <li>• A number of researchers and experts speculated that a service-led economy could separate economic growth from growth in material and energy throughput, leading to an overall greening of the economy. However, while services tend to be less material and energy-intensive per dollar of output than manufactured goods, the service transition has not reduced absolute material and energy throughput in the economy. Because the service economy depends fundamentally on the industrial economy_ p. 11</li> <li>• while servicizing generally is not necessarily green, certain models can be strongly so, and these are clustered under “results-oriented” models. _ p. 18</li> <li>• The discussion to this point, and particularly the discussion of greening mechanisms in the tables above, raises a critical question: what environmental performance gains does “Green Servicizing” achieve in practice over BAU? (Or more generally, what sustainability performance gains are achieved, where sustainability requires consideration of social, not just environmental, performance.) otherwise less, with worse-than-usual performance possible in some leasing cases. _ p.37</li> <li>• <u>Car-sharing does not offer an alternative to personal and corporate ownership of vehicles in all segments of the vehicle market _ p.58</u></li> <li>• The primary barrier to car-sharing as an alternative to ownership for individual customer is the intangible value assigned to car ownership.</li> <li>• In other cases, they have not been: for example, rising incomes and technological change have reduced the US market share of PSSs such as laundries, public baths, and public transport systems, replacing them with less eco-efficient—but often more convenient—private ownership of products and infrastructure to deliver the same basic function (i.e., washing machines, in-home plumbing, private automobiles).</li> </ul>
Kang(2009)	<ul style="list-style-type: none"> <li>• PSS offers are challenged by the absence of product ownership, by the trade of intangible and/or temporary service values, and by concerns about convenience, privacy and security.</li> </ul>

[Table 2] points out that PSS cannot replace product sales model or sustainability effect appears high actually due to the problem on whether consumer’s ownership or convenience meets demand is only limited to some models – result-oriented PSS-. The result-oriented PSS is one of three types of PSS [figure 2] and to pay the cost as much as using the product which is the biggest feature. For example, when a household uses water-purifier, if you pay same cost every month regardless of use like rental business of Coway, it is use-oriented PSS and if you pay the cost according to the use, it is results-oriented PSS. In results-oriented PSS, user abstains from using to reduce his own economical burden, therefore sustainability is improved.

<sup>3</sup> EU EPA (2009) Green Servicizing for a Key concepts, tools and analyses to inform policy engagement, Office of Resource Conservation and Recovery

PSS Type	Key characteristics	Examples
<i>Product Oriented PSS (POPSS)</i>	The consumer owns the product; a company provides additional services to assure the functionality, durability and performance/use of the product.	Service contract for maintenance, repair and take back added to high tech products.
<i>Use Oriented PSS (UOPSS)</i>	Service provider owns the product, selling only the function to customer through a service contract.	Car sharing; serviced office space.
<i>Results Oriented PSS (ROPSS)</i>	The customer buys results and is not concerned with how those results are delivered.	Selling pest free fields instead of pesticides; selling thermal comfort in buildings instead of heating and cooling equipment (contracting); selling high quality application of chemicals, instead of selling the chemicals (chemical management).

Figure.2 Typical classification of PSS

As a result of analyzing barriers of PSS sustainability through prior researches, it could be confirmed the cause that sustainability decreased was placed on not only producers(companies) but also consumers. Although most concepts of sustainable PSS were defined as ‘Despite of less material consumption, Consumers would be satisfied by immaterial and intangible services in PSS’, it might not really be so because the need of consumers was still focused on material consumption rather than based on sustainability and recycling of resources. Although PSS is one of the most optimistic business models combined with intangible service which can reduce material consumption, it is not environmental impact never occurs. If consumers want more services, companies will provide them to maximize consumer satisfaction and it consequently brings the decline of sustainability. In conclusion, PSS cannot maximize sustainability only by the change in the aspect of producer and consumers need to change the sense of value that consumption was virtue, the need and behavior following it. Sustainable PSSs usually require fundamental changes in customer behavior, practices, and mental frameworks<sup>4</sup>.

Therefore this paper would suggest future research direction on PSS development that can maximize consumer satisfaction and improve sustainability at the same time by inducing the change in the aspect of consumers.

Commonly, the main barrier to adopting PSS in developed countries is the cultural shift necessary for companies and customers both. Especially, customers are needed to change their value ‘having a need or want met in a sustainable way’ as opposed to ‘owning a product’.

Omann(2003) also indicated that ownership is an important factor for consumers and there appears to be a psychological barrier which prevents consumers from turning away from possessing things towards their common use. As observing the formal studies, the barriers of PSS's sustainable implementation don't depend on only companies but consumers. Most definitions of sustainable PSS describe the reason why PSS basically sustainable as [Table 1] .

<sup>4</sup> Carlo Vezzoli et al., (2012) Why have ‘Sustainable Product-Service Systems’ not been widely implemented? Meeting new design challenges to achieve societal sustainability, Journal of Cleaner Production, p 2

- Despite of less material consumption, Consumers would be satisfied by immaterial and intangible services in PSS

However, as long as consumer consider that products serve as means not ends, sustainable effects in PSS sometimes can be decreased. Especially, several PSS models - product renting, sharing and pooling - can achieve significant sustainable performance gains when the use phase is a significant source of impacts, but the model results in significantly reduced use levels of the product by individual customers. Therefore pay-per-use models also will tend to reduce use levels but some customers may negative yet.

In regard to consumers' sustainable consumption, several studies also argue that current consumption practices and consumer behavior can't be called "sustainable", as defined by the United Nations World Commission on Environment and Development (WCED, 1987). And they emphasized that without substantial changes, in the long term these consumption practices can't arrive sustainable business ecosystem.

According to the former researches and cases, the main consumer barriers in implementing PSS which are summarized as follows : ownership, inconvenience, the lack of values for resources recycling, sustainable consumption. There is a need for consumers' paradigm shift for material consumption.

This paper presents a plan and construction for future research which focuses on the consumer aspects, it is offering the PSS development strategy to improve consumers satisfaction and sustainability in the same time as influencing consumers.

### **3. Improving PSS's sustainability by influencing customers**

#### **3.1 Values and behaviors in sustainable consumption**

Studies on Influencing people have progressed in the fields of psychology, sociology, behavioral economics, etc. and is nothing new to government, which has often used tools such as legislation, regulation or taxation to achieve desired policy outcomes. And companies have investigated consumer' psychology and behaviors on consumption to apply design, marketing, advertisement. Especially, as climate change is becoming severe, various products on reducing greenhouse gas, energy saving and code of conduct in routine life are being delivered to consumers. And, the worry about how to make more sustainable product, service, and policy was now changed to a problem about how to let consumers participate in and use what were suggested. Like this, inducing consumer's sustainable behavior is difficult problem. While there are several factors changing human's behavior, there are several prior researches which focus on consumer's sense of value with respect to sustainable lifestyle, consumption behavior [Table 3], [Table 4].

Table 3. Customer values and sustainable behaviors, lifestyle

Customer values and sustainable behaviors, lifestyle
<ul style="list-style-type: none"> <li>• A value is usually defined by psychologists as a 'guiding principle in the life of a person' (Schwartz, 1992).</li> <li>• There are some important practical implications to this research: people who hold 'self-transcendent' values</li> </ul>

(especially pro-environmental values, and high levels of altruism) are more likely to engage in sustainable behavior (Stern, 2000), show higher concern about environmental risks like climate change (Slimak and Dietz, 2006), are more likely to perform specific actions such as recycling (Dunlap et al., 1983) and are more likely to support climate mitigation policies (Nilsson et al., 2004).

• - <http://talkingclimate.org/guides/values-frames/> -

• Influencing people's behavior is important for more sustainable lifestyles.

• - UK Defra, 2008 -

• Values guide behavior by contextual and habitual reasons.

• Our values—which represent a strong guiding force, shaping our attitudes and behavior over the course of our lives. Our values have been shown to influence our political persuasions; our willingness to participate in political action; our career choices; our ecological footprints; the amount of resources we use, and for what purpose; and our feelings of personal wellbeing. (Schwartz, S. ,2011)

- Common Cause Handbook, 2011 -

Table 4. Sense of values of green practice leading groups examined by overseas cases

Division	Key word of values
Securing base of natural life	Conservation of nature, environment protection, ecology, sustainability
Common life	Definition
Relationship with others	Solidarity, common responsibility, attitude to help others
Principle of life	Self-government, self decision, freedom
Object toward self inside	Characteristic growth, personality, ability, knowledge
Mutual communication	Cooperation
Association with life	Spirituality, religion
Value to be moved to behavior	Filling life's meaning
Relation between nature and human	Nonviolence, awe on life and love

Source: Degenhardt(2007)

Some people who have more sustainable lifestyles show a certain values such as self-transcendent. Some of values have changed for hundreds of years. However, according to a recent research result on 50 Korean green consumers, - they had strong differentiated values about permission of nature's right, coexistence awareness, and equal awareness – The reason why consumers had this values was attributed not only to long term impact but also mainly to a case that certain event provided momentum of values change<sup>5</sup>. Also, some psychology experiments showed a study result that certain behavior changed the belief itself. Through prior study result on value and behavior, this study set a hypothesis that value and behavior were at mutual relationship (affecting each other).

### 3.2 A Suggestion of Design Framework for influencing behaviors centered consumer values

<sup>5</sup> Oh, Sung\_ho, An\_Byeong-ok et al., (2012) A study on how to spread the green culture in korea, Presidential Committee on Green Growth(PCGG), The Republic of Korea



This study began from a question on whether the sustainability of PSS known as sustainable business model can be improved and if it declines, what the cause was. And, as a result of analyzing several prior studies, it could be confirmed the cause of sustainability decline of PSS was a problem of consumers as well as producers. With this, it set a future research direction to develop PSS which can satisfy consumers by approaching from consumer aspects and improve sustainability at the same time.

It is shown the overall construction of future study as [Figure. 3]

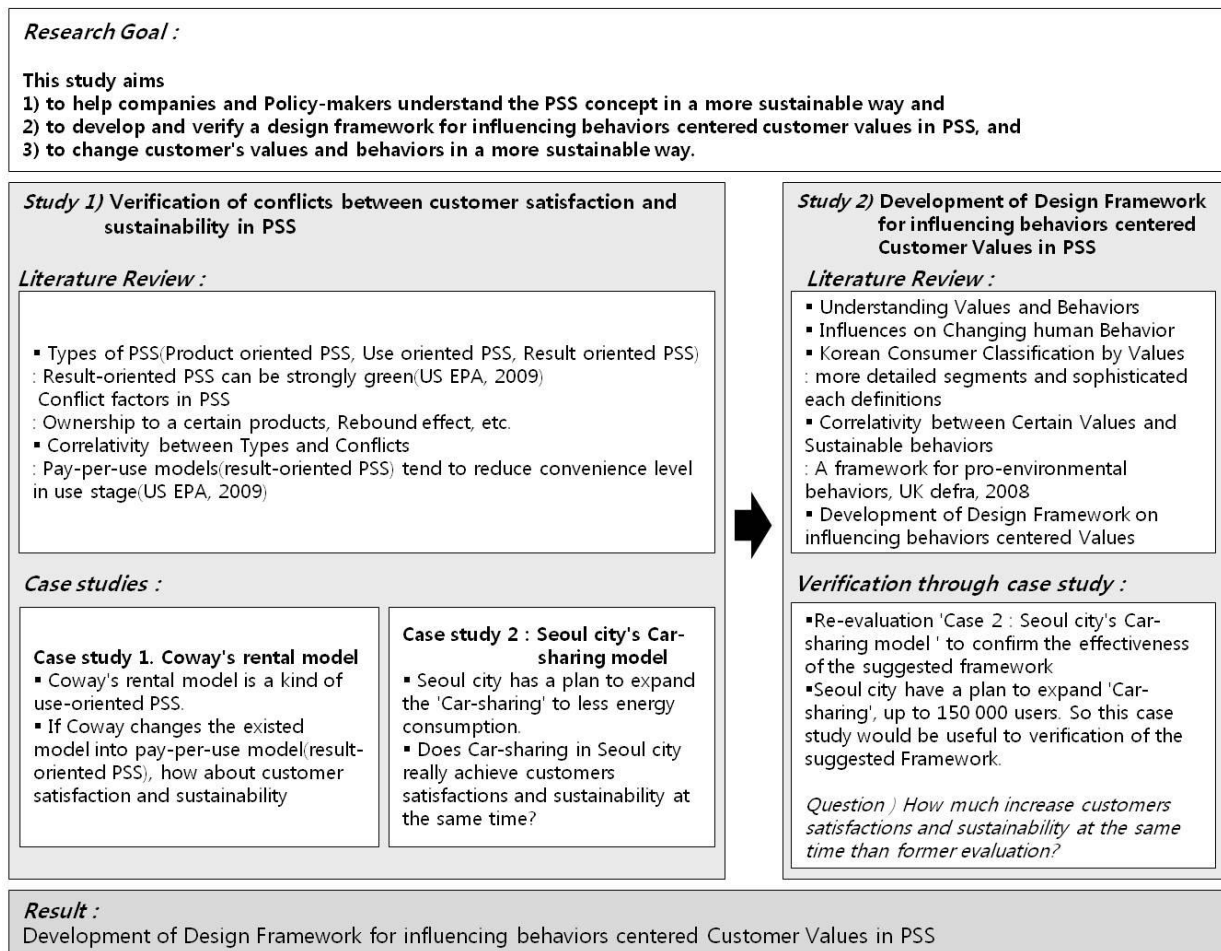


Figure.3 Structure of the future study

#### 4. Examples Citations

- [1] KANG, MYUNG-JOO (2009) *Development of Sustainable and Competitive Product Service System Solution* Product Service System Solution Verification and Improvement of Methods and Tools, TU WIEN, Austria
- [2] EU EPA (2009) *Green Servicizing for a Key concepts, tools and analyses to inform policy engagement*, Office of Resource Conservation and Recovery, EU EPA
- [3] Tim Holmes et al.,(2012) *The Commom cause handbook*, UK
- [4] Paul Dolan et al., (2009) *MINDSPACE :Influencing behaviour through public policy*

[5] Carlo Vezzoli et al., (2012) *Why have 'Sustainable Product-Service Systems' not been widely implemented? Meeting new design challenges to achieve societal sustainability*, Journal of Cleaner Production

[6] Oh, Sung\_ho, An\_Byeong-ok et al., (2012) *A study on how to spread the green culture in korea*, Presidential Committee on Green Growth(PCGG), The Republic of Korea