

Sustainability in Design: Now!

**Challenges and Opportunities for Design Research,
Education and Practice in the XXI Century**

Edited by Fabrizio Ceschin, Carlo Vezzoli and Jun Zhang



**Proceedings of the
LeNS Conference, Bangalore, India
29th September to 1st October 2010**

Volume II

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Overcoming barriers to adopt Product-Service Systems (PSS)

A case study from Turkey

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The notion of Product Service Systems (PSS) is being investigated by many scholars as an innovative way of achieving dematerialization towards sustainability. Beside successful PSS examples, barriers for shifting towards PPS are also identified in the literature. However, adoption of a successful PSS model might need a transition phase to overcome the pitfalls.

The objective of this research is to identify and to discuss the possible strategies to overcome business and technology related barriers to adopt a PSS in a developing country. The paper further examines the recognized drivers and barriers for shifting towards service oriented business models from the literature. An exploratory case study about a Turkish company is also presented to make a comparison with a successful Italian case. The paper concludes with a set of lessons learned from the case study and critical business factors that companies and entrepreneurs should be aware of when designing strategies for service oriented business solutions.

Introduction

Sustainability is one of the core themes of many disciplines and presents a truly global challenge for product developers regarding with material consumption and resource utilization. Towards the transition to sustainable production and consumption, state business models need to be reviewed in order to realize a radical system innovation.

Product Service Systems (PSS) provides an opportunity for potential dematerialization of consumption. In this manner, many successful PSS models are discussed in details in the literature. Possible drivers and barriers for adoption of PSS models are also discussed by many scholars. Besides analyzing drivers and barriers of different PSS cases individually, comparing business models which provide same kind of product and / or service would support the literature with an understanding about the impact of different circumstances on the success of a PSS model. This paper aims to identify the impact of country related economic, legal and social circumstances on evaluation of a PSS model.

A brief literature review has been done about the possible drivers and barriers for shifting towards more service oriented businesses. To provide more insight about the critical factors that contribute to the companies' decisions to shift, and to understand the situation that supports or blocks the adoption of PSS in a developing country, an exploratory case study on a Turkish company is conducted. An existent and simple example, the Italian business case on textile floorings for trade fairs, is chosen to make the comparison. It was expected that same model could be adopted in Turkey as a best practice. Stakeholders of the system and the material flow were identified in a system map. Interviews with open ended questions were conducted to understand stakeholders' expectations about products. Drivers and barriers from the literature are used to analyze the business case. Finally, opportunities of improvements in the actual PSS and a complete new PSS model are discussed.

Background

Sustainability can be defined as a dynamic process that enables improving the quality of life while simultaneously protecting and enhancing the earth's life support systems (Sherwin, 2004). From this perspective; sustainable design considers that environmental, economic and social impacts occur throughout the product lifecycle (Lilley, 2009). Economical, environmental and social domains are the three pillars or triple bottom line of sustainability. Defining solutions for those three domains requires system thinking while designing and developing products. In theory there are many studies concerned with the economical and social domains of sustainability however in practicality, it is more about eco-design which includes improving existent products for less harming effects to the environment (Sherwin, 2004). There are several methods and concepts for more sustainable product development and manufacturing (Kaebernick, 2003). However it does not help to create big positive impact on the environmental effects of products, that's why there is a need for a systematic change (Morelli, 2002; Nuij, 2001).

As a result of the nature consumption pattern, customers are becoming more and more demanding than they used to be; they consume products faster and ask for newer versions. Thus, companies need to shorten their innovation cycles and build strong relationships with customers and other stakeholders. Increased demand of customers is met in a material and energy intensive way. As consequences of this situation, in near future resources will not be enough to provide wealth for the same amount of people with the same life standard they have now. Mont (2002a) stresses two strategies for altering this chaos; increasing resource productivity to cover consumption trend or reducing resource consumption. It is obvious that the first option cannot be achieved. However the second option is much more possible, which is a promise of dematerialization (Mont, 2002a).

In sustainability literature, much has been written about the concepts of eco-design, sustainable design, eco-innovation, eco-efficient products or eco-effective design and sustainable innovation. Sherwin (2004) discusses how the ideas behind these concepts range from changing the nature of the product to reduce impacts to rethinking an entire system that may contain a new product or service. At this point, PSS aims a system innovation through selling end result instead of products (Mont, 2002a). This kind of dematerialization promises positive impulse for both environmental and business related progress. In this manner PSS is being discussed widely from late 80's as the economy is also changing from being supply driven to being demand driven (Baines et al., 2007; Mont & Lindhqvist, 2003). PSS framework describes new types of stakeholder relationships, new convergence of economic interests and potential systematic resource optimization. Baines, et al. (2007) defines PSS as an integrated product and service offering that delivers value in use. (Manzini, 2003) classify PSS in three categories:

- Providing value added to product life cycle
- Providing final result to customer
- Enabling platforms to the customer

While in theory PSS has the potential to bring improvements on sustainability, it is not always a part of the system. 'PSS equals to sustainability' is just a myth for many cases (Tukker & Tischner, 2006). Providing service with the product is not the way of gaining sustainability but increasing material consumption many times. Thus, developing sustainable PSS models needs system innovation where dematerialization occurs. Mont (2002b) underlines that existing PSS examples are not always more environmentally benign and successful in gaining economic sustainability. This win-win situation occurs in some business models while for some others it is expected not that realistic (Tukker & Tischner, 2006). To gain the environmental benefit of service oriented business, economically successful and environmentally sustainable PSS examples should be transferred into different fields in different markets. Mont (2002b) discusses that in order to develop PSS scenarios for different circumstances, it is necessary to know what kind of pitfalls exist and what can be supported for those companies to overcome those barriers.

Drivers and barriers

In PSS literature many scholars mention the presence of drivers and barriers for shifting to PSS or gaining success with PSS. Cooperation between educational institutions, governments and NGOs towards more service oriented product-service system development (Brown, Vergragt, Green, and Berchicci, 2003) increased relationship between customers and producers, availability of demand for recycled or recovered

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products in the market (Besch, 2005), availability of reverse logistics in the market (Rahimifard, Coates, Staikos, Edwards, and Abu-Bakar, 2009) are proposed as drivers for service oriented business development. As one of the most systematically presented one, the classification done by Mont, (2002b) which organizes drivers and barriers in two large categories, was used as a basis to produce Table 1. Other contributions from the scholar were added in the table.

Table 1: Drivers and barriers identified in the literature

Derived from Mont, 2002b

	Drivers	Barriers
External	<p>Coercive:</p> <ul style="list-style-type: none"> Public concern (Mont, 2002; Mont & Lindqvist, 2003) Cooperation between universities, NGO's research institutions (Besch, 2005) Legislation (Mont, 2002b) <p>Market drivers:</p> <ul style="list-style-type: none"> New possibilities for growth (Mont, 2002b) Service demand of customer (Mont, 2002b) Increased relationship between customers and producers (Besch, 2005) Demand for recycled – recovered product in the market (Besch, 2005) 	<p>Relationship between actors:</p> <ul style="list-style-type: none"> Conflict of interest between actors (Mont, 2002b) Lack of demand from customer (Mont, 2002b) Lack of customer's knowledge (Mont, 2002b) Lack of customer acceptance (Mont, 2002b; Tukker and Tischner, 2006) <p>Regulatory barriers:</p> <ul style="list-style-type: none"> Lack of public procurement (Mont 2002b) <p>Context-related barriers:</p> <ul style="list-style-type: none"> Relatively low price of resources (Mont, 2002b) High labor price (Mont, 2002b)
Internal	<p>Resource drivers:</p> <ul style="list-style-type: none"> Cost reduction opportunities (Mont, 2002b) <p>Management decision:</p> <ul style="list-style-type: none"> Top management's will towards service oriented business (Mont, 2002b) <p>Environmental performance:</p> <ul style="list-style-type: none"> Company's proactive role on environmental concerns (Mont, 2002b) 	<p>Cost-related barriers:</p> <ul style="list-style-type: none"> Use related costs (Mont, 2002b) Uncertainty of cash flow (Mont, 2002b) Lengthen time to market because of increased product development time (Mont, 2002b) <p>Concept design barriers:</p> <ul style="list-style-type: none"> Uncertainty about the return flow of products – reverse logistic (Besch, 2005; Mont, 2002b; Rahimifard et al., 2009) Conflict in customer priorities and environmental performances of the product-service (Mont, 2002b) Product related limitations –fashionable products (Mont, 2002; Besch 2005) <p>Organizational barriers:</p> <ul style="list-style-type: none"> Conflict between organizational functions (Mont, 2002b)

Research method

In this exploratory case study, the challenges were to analyze the existent system in Turkey with its actors and business model, and to compare the same business case with a successful PSS application in a developed country. The goal was to identify possible barriers and drivers that are faced while adopting a suc-

successful PSS model from a developed country into a developing one. Moreover, outcomes of the research were expected to be useful in similar adoption projects in similar circumstances.

The Italian case study mentioned by Manzini (2003) is used as the basis for the case study research in Turkey. Manzini (2003), in their paper, point out the environment friendliness award winner Italian carpet company called Diddi&Gori S.P.A. that produces textile floorings for trade fairs. Diddi&Gori S.P.A. provides carpets to trade fairs and recycles used carpets to produce new carpets. This cycle is quite effective both economically and environmentally. This is a successful PSS case that also achieved sustainability with a closed material loop.

This case was chosen as the basis for comparison because same customers (trade fairs) and producers (carpet manufacturers) exist in the Turkish market, and the product (carpet) fulfills same functions in Turkish trade fairs. Since it is a B2B market, less cultural barriers and more relationships between companies were expected compared to a B2C market. Thus, exploring this case would bring a possible comparison with a successful example and understanding about the PSS application in Turkey.

Main research questions that shaped the case study interviews were:

- How does the business work in Turkey?
- What kind of drivers and barriers are existent to adopt the Italian case?
- What are the possible opportunities for improvements?

For the case study following steps were used:

- The system and its stakeholders were defined.
- Actors in the value chain were identified. Interviews with open-ended questions were conducted to understand their expectations and priorities in the market.
- Actual status of the system was analyzed in terms of sustainability. Drivers and barriers were analyzed and compared with the ones identified in the literature.

Interviews were conducted with two visitors and two contributors of the trade fair, procurement manager from the trade fair organization, an engineer from a carpet manufacturing company's production department and with the owner of the carpet provider company.

There are many trade fair halls all around Turkey. However Istanbul is the biggest fair centre of Turkey while Izmir and Antalya follow after. Largest and busiest trade fairs are CNR and TUYAP from Istanbul. Procurement manager from CNR was interviewed to analyze the system.

There are only a few carpet providers in the market. Thus, only one of these companies, which provides service to those important trade fairs, was chosen. Trade fair visitors and contributors were chosen randomly during the same fair organization. The carpet manufacturer company was chosen according to its location and proximity to Istanbul, which would make it easy to organize an interview.

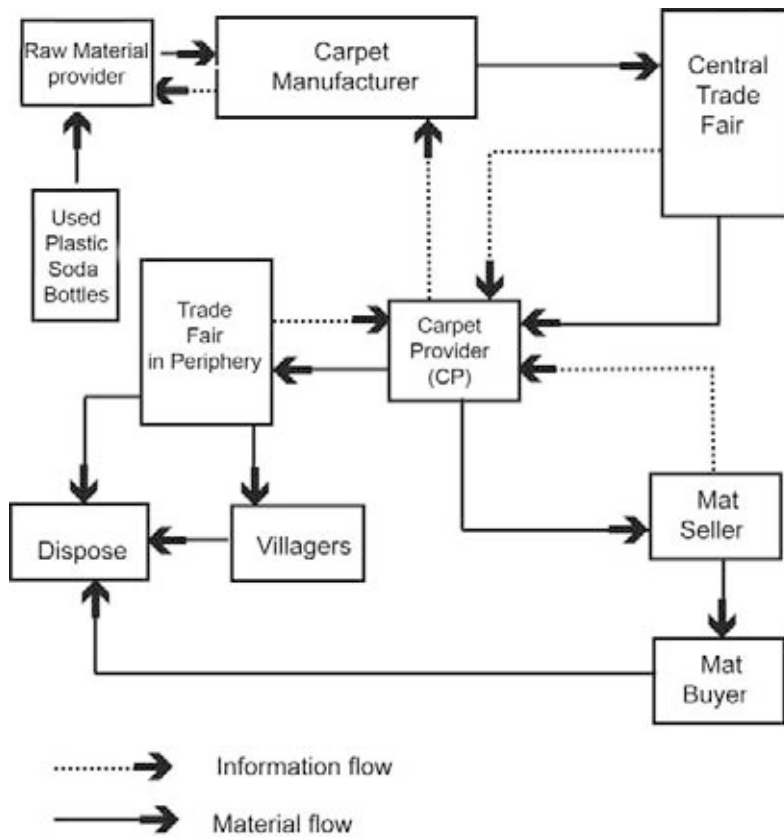
Case study

Stakeholders of the system

Seven main stakeholders were defined in the lifecycle of the trade fair carpets. They are presented in the Figure 1. Trade fair visitors and contributors were not included in the value map since they are not really included in the material flow.

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Figure 1: The system map



Trade fairs

CNR EXPO has the biggest trade fair facility of Eurasia. It has around 150.000m² closed area where 8 halls are located. Each fair is held for around five days. Carpets are mostly used in the walking area and sometimes at the pavilions. According to the procurement manager, in CNR approximately 450 000 m²/year of carpet is used and it is not possible to use a flooring solution for the next fair because layout of the trade fair changes for each organization.

The product

Trade fair carpets used in CNR are produced by using PET (polyethylene) material. Even though there are pure PP (polypropylene) carpets and PP – PET mixed carpets in the market, CNR prefers the PET because of low cost. PET carpets are produced by using recycled plastic soda bottles mixed with virgin PET granules in the manufacturing company. PP carpets are able to recycle however PET carpets are not. There are different colors and two different types of thickness of trade fair carpets.

The carpet provider (CP)

CP is an Istanbul based carpet provider for trade fairs in Turkey and abroad. CP does not produce carpets but buys from different manufacturers all around Turkey. Company has a workshop equipped with a machine for rolling and one for cutting used carpets to produce mats out of them. The company is in close relationship with almost all trade fair procurement managers and carpet manufacturers that produce PET basis carpets. Thus, market is a kind of monopoly.

Company provides full service of installing, maintenance and removing carpets for trade fairs. Carpets are glued to ground during the installation. Used carpets from central trade fairs are reused in smaller fairs in periphery if the carpets are not damaged. If carpets are not good enough to use for another fair organization or in case there is no fair in near future, then company produces mats to sell in national and foreign market. Reused carpets in the periphery are most of the time given away to people in small villages to be used on the ground of their barns.

The carpet manufacturer

Most of the carpet manufacturers are located in western regions of Turkey. Interviewed carpet Manufacturer company located in Bursa which is in the same geographical region of Istanbul. Manufacturer produce different kinds of synthetic carpets for offices or residencies in general and they produce trade fair carpets if there is a demand. The company produces trade fair carpets out of PET, PP and mixed materials. However, they don't have recycling facilities for PET or PP and they purchase raw material from other companies.

Analysis

Barriers for the manufacturer company

Different than the Italian case, here the producer company is not involved in providing service to the customer. There are several barriers for manufacturing company to enter this market. Firstly, the manufacturing company actually is not equipped with recycling machines. This requires an investment cost. As the production engineer also mentioned during the interview; providing carpets for the fairs around their region would supply only a small increase in their profit. Cost of new machines, hiring new team for service and logistics of recovered products are use related costs and create a barrier for the company.

Even though PP carpets are produced by the manufacturer company and also there are companies that recycle PP carpets, because of the high price compared to PET, they are not appreciated by the customer. There is a conflict between customer priorities and the environmental performance of the product.

Drivers for the CP

Customer's demand for service is a valuable driver for this business model. As the owner of the carpet provider company also mentioned that they would never identify such a business unless his friend in trade fair organization had pointed out. For trade fairs, especially for busy ones, service is necessary as the procurement manager also underlined. On the other hand relationship and mutual trust is important for both sides to run the business. This is something hard to gain for the manufacturing company since it is not their main business and it creates an opportunity for the carpet provider company. However it is an easy top management decision for the carpet provider company since it is much smaller and flexible.

Even though offering service was related to the customer demand, lengthening the product's lifecycle is done because of the cost related drivers. Used carpets are still valuable in the market as flooring textile for another customer profile which expects less quality, or as another type product. This indicates the demand for recovered products as a driver for this business. On the other hand, giving away the used carpets in trade fairs far from center, is not only related to social philanthropy but also a cost related decision since it is much more expensive to transport them back than to benefit from them in mat production.

Trade fair carpets are used same as it was in Italian case, the product service that customer gets is almost same. However, there is a mediator company which uses the opportunity in the market. The main concern of carpet the provider company is profitability, not environmental concerns. Even though the lifespan of trade fair carpets are lengthened by secondary use in different ways, the material loop is not closed as it is proposed in the Italian case. To close the material loop, carpets have to be recycled fully by the end of its lifespan. As the production engineer of carpet manufacturer-company also pointed out, main problem about recycling is the heterogeneous structure of the PET carpet. All PET carpets have soles that create problems during the recycling processes. Changing the structure of the carpet with a new product design could be an opportunity for closing the material loop. However the only way to close the material loop is to produce PP carpets.

Demand from a few trade-fair is not good enough compared to the profit that could be gained from offices and residences with much more expensive products. Thus, investing in this service oriented market is not profitable for the manufacturers with these circumstances while they are producing and selling carpets anyway. Another barrier to invest in PP carpet business by the carpet manufacturers is the lack of demand from customer.

Neither the manufacturer nor the provider thinks that there is a support of public policy for investing in more environmentally friendly production. Thus, it is not possible to mention legalization as a driver as

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it was in the Italian case, where the company got funds from EU for this project (Walsh, n.d.,) and awards (Manzini, 2003).

Since entering the market as a mediator is not that difficult, to reduce the risks the carpet provider company tries to strengthen its position in the market by increasing relationships with manufacturers and the customers. This network brings possibilities for innovation in product and service.

Conclusion

This is an interesting example compared to other PSS cases. Difference is that the company is not producing anything in fact. This company is extending product life span while a final result is presented to the client. CP could be an example for situations where clients ask for more service instead of product and manufacturers are not willing to enter service oriented business, whether because of low profit or high risk. Mediator companies can create solutions for more sustainable systems when it is not easy to reach fully closed material loop solutions. In such a case, the mediator company takes on the responsibility of the product and the risk of business. This situation can be identified as a transition phase to sustainable PSS.

Obviously, it is not profitable for any company to produce carpets fully recycled with conditions in Turkey. Mont (2002b) gives the sustainable PSS example of Interface, the American carpet company, and points out that they are not really profiting from this part of their business. It is more about the company's proactive role about environment. In a developing country, it is not easy to expect such a proactive strategy. However, support of public policies, availability of proper technology and legislation could be important drivers for companies to act towards more service oriented business (Mont & Lindqvist, 2003).

This paper has presented a PSS case from Turkey with a comparison of a similar Italian PSS case that was described before. Difference between situations and company strategies give insights about how PSS can be adopted in different conditions and how a transition phase could be developed for situations where manufacturer companies find it risky to move towards more service oriented business.

Much more interviews with carpet manufacturers and trade fair organizations are necessary to describe a better picture. Also recycling facilities should be involved in the system where they play an important role in transition. Another missing part is the evaluations of sustainability status of the business case where only a broad analysis was presented here. Producing PP carpets and PET carpets might create different impacts on environment. They all should have been included in the analysis.

For further research about this issue, new scenarios could be built and compared with the actual situation by evaluation tools. Focusing on the homogeneity of the product structure and eliminating other chemicals for fixing it to the ground could be a starting point for development. Analyzing customer expectations would result in a new understanding about the function that clients demand. Such information is useful for designing a better product-service mix.

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