

**PSS strategies associated to the development of durable products:  
Propositions for the transition to sustainable consumption patterns**  
*Estratégias de PSS associadas ao desenvolvimento de produtos duráveis:  
Proposições para a transição para modelos sustentáveis de consumo*

Cláudia R. Hasegawa Zacar<sup>i</sup>

Jucelia S. Giacomini Silva<sup>ii</sup>

Maristela Mitsuko Ono<sup>iii</sup>

*Design, Product-Service System, Durability*

*This paper is based on a critical review of the literature aimed at the analysis of current rates of production and consumption and the concept of Product Service Systems (PSS), which is part of the more contemporary aspects of design for sustainability. It discusses strategies of Product-Service Systems (PSS) design and the feasibility of implementing its tools for the development of durable products. The extension of the artifacts lifespan is seen as a way of promoting more socially and environmentally suitable consumption patterns, since a durable product delays the need for replacement and renewal, and consequently the production of new artifacts, thus limiting the generation of waste and its environmental impacts. Therefore, the development of durable products, supported by PSS tools, might be helpful in the transition to new lifestyles.*

## 1. Introduction

Our society has faced increasing socio-economic and environmental problems and, in this context, design has a different role to play, in comparison to what was usual in the last century, as argued by Tischner and Verkuil (2006). Already in the 70s of the last century, Papanek (1984) has identified the social responsibility of the designer and the environmental problems resultant from mass production. From this new perspective, the design activity is no longer seen as a part of the problem (considering design as a field of knowledge that supports the current consumption patterns), but intrinsically belongs to the whole of a systemic solution, in regards to the sustainability challenge.

With the evolution of the environmental discourse, the design field has received profound influences, since it began to question its main competency, which, along the history of design, has been linked mainly to the creation of new products. Since then, designers and researchers have searched for viable directions to contribute with solutions focused on sustainable design, guiding efforts in order to raise awareness, build capacities and implement practical procedures that contribute to the development of sustainable economies through actions, tools and strategies aimed at profound changes in current lifestyles.

Nowadays, several authors defend the idea that design should help to transform the current profile of production and consumption patterns, leading to the solving of real problems and to effective changes in order to make these systems more sustainable (Lewis et al 2001; Manzini; & Vezzoli 2002; Sherwin 2004). As argued by Manzini and Vezzoli (2002), sustainability should be considered more as a systemic condition to be enhanced than a direction to be followed.

In parallel, it is observed a constant increase in the rates of consumption of goods in the industrialized nations in the last decades, and a rapid growth of these rates in many developing countries such as China and India, which still have great potential to expand their number of consumers. (World Watch Institute 2004).

In Brazil, the consumption rates are also increasing. Recent researches showed that between the second trimester of 2008 and the same period of 2009, this growth was of 3,2%. (Vieira 2009). Moreover, it is possible to perceive a discreet increase in the consumption of durable goods among the low-income population (Souza 2007), due to the raise of the minimum wage, the greater economic stability, the increased number of formal workers and the expansion of credit, in addition to the distribution of resources by social programs such as "Bolsa Família" (Bastos 2008). Nevertheless, the 50% poorest people still represent only 17% of the market, while the richest 30% are responsible for 75% of the consumption in Brazil. (Souza 2007).

In this context, this paper discusses some possible interconnections between design and more socially and environmentally suitable consumption patterns, seeking to present the feasibility of applying PSS strategies in order to promote the extension of products lifespan. Therefore, it is proposed that this extension, associated to PSS strategies, is a way to start the promotion of new lifestyles. Thus, it might be helpful in the process of transition to a more sustainable society, allowing design to act as a strategic factor, offering eco-efficient approaches to business and consumers, based on environmental, cultural and socio-ethical requirements, besides the economic ones.

## 2. Consumption and sustainability

As mentioned before, the levels of consumption, especially in developing countries such as Brazil, are in constant growth. In spite of the benefits of the democratization of access to goods, it is important to consider that if the current consumption levels of the richest people could be replicated to a half of the population of 9 billion people, expected to the year 2050, the socio-environmental impacts would be quite severe. Nowadays, the impacts created by the society of consumption can already be observed, since the economies still give little attention to the waste generated by production and consumption processes. (World Watch Institute 2004).

In Brazil, there is an increase in the generation of garbage per capita in direct proportion to the number of inhabitants (IBGE 2000), an increase also related to the changing habits of the population, due to the current models of production and consumption (Capellini 2007). According to the IBGE, 125,281 ton of garbage were daily collected in the year 2000, in all

Brazilian cities. This large and growing amount of waste has caused environmental, economic and social impacts, representing a serious problem of urban planning. (Capellini 2007).

Besides these impacts arising from the increase in waste generation there is the problem of exponential increase in the use of resources to manufacture new goods. As indicated by Manzini and Vezzoli (2002), it can be considered as sustainable only those production and consumption systems in which the use of resources is at least 90% lower than what currently occurs in most industrially advanced societies.

In addition to environmental impacts, it is also important to consider that the increase of consumption and wealth does not necessarily help people to have more satisfactory lives. The excessive search for the accumulation of possessions may be related to a decline in health and quality of life indicators in many countries, notably in relation to the increasing of obesity and crime rates, as well as other social problems. (World Watch Institute 2004).

In this context, it becomes clear the importance of an analysis of current patterns of consumption, as well as of motivations, expectations and behaviors of consumers, aiming at altering these patterns in favor of more environmentally friendly practices, as in the models of "sustainable consumption" and "slow consumption" (Cooper 2005). To Jackson (2005), these models could bring a double benefit: a better quality of life alongside a significant reduction of impacts to the environment.

One of the possible ways to achieve a more appropriate model of consumption is to optimize the lifespan of products through the increase of their durability (Cooper 2005). According to Kazazian (2005), a product that has its life prolonged delays the need for replacement and renewal, and consequently the production of new artifacts, thus limiting the generation of waste and its environmental impacts.

Durability can be defined as the ability of the object to be registered in a certain permanence (Kazazian 2005), or its ability to perform the required functions for a long period of time, without excessive expense on maintenance and repair (Muis 2006).

To Muis (2006), no aspect of product quality is more important, economically and environmentally, than durability, as it directly affects the frequency of repeated purchases from consumers and, consequently, the profit of producers, the volume of accumulation of goods and the rate of consumption of natural resources.

According to Kazazian (2005), different approaches are possible to increase the durability of a product, in accordance to the stages of its lifecycle. It is possible, for example, to use materials better suited to aging, to encourage repair and maintenance, to facilitate changes and upgrades, among other options. Cooper (2004) suggests that the development of durable products may also involve political actions, such as the formulation of discarding fees and the implementation of educational programs, in order to give people information and confidence to respond to marketing and social pressures.

To Cooper (2004), it is possible to observe a latent social demand for more durable products, even if, in general, people associate the extended lifetime of a product more to its quality rather than to environmental issues.

So far, however, the strategies for optimizing products lifetime have been relatively little explored, both in theory and in practice. A possible explanation for this is their apparent contradiction to the economic interests of capitalist companies (Van Nes & Cramer 2003). However, analyzing the new fronts of research in design for sustainability, it is possible to conceive ways to facilitate the development of durable products in the context of the capitalist system, through the implementation of PSS strategies.

It is worth mentioning that sustainability is also related to cultural and social dimensions, besides economic and environmental factors, amongst others, thus demanding a systemic and interdisciplinary approach. Furthermore, an environmental good solution is not necessarily sustainable, and there the extension of product lifespan does not necessarily determine a lower environmental impact. According to Manzini and Vezzoli (2002) there is a limit to the potential duration of a product, called point of break-even, from which the substitution for a new and more efficient product will present a lower environmental impact. This occurs mainly on durable goods whose environmental impacts are larger in the use phase.

It is also suitable to remark that besides extension strategies, the optimization of a product lifespan may also involve intensification strategies for products and services, aiming at enhancing a systemic condition of sustainability (Manzini & Vezzoli 2002).

### 3. New design dimensions for sustainability

Since the theme of sustainability appeared in international discussions, it has been observed the emergence of concepts and theories related to design processes and the need to recognize the environmental limits in the design of products and services, aiming at a greater contribution in benefit of the environment and society. (Sherwin 2004).

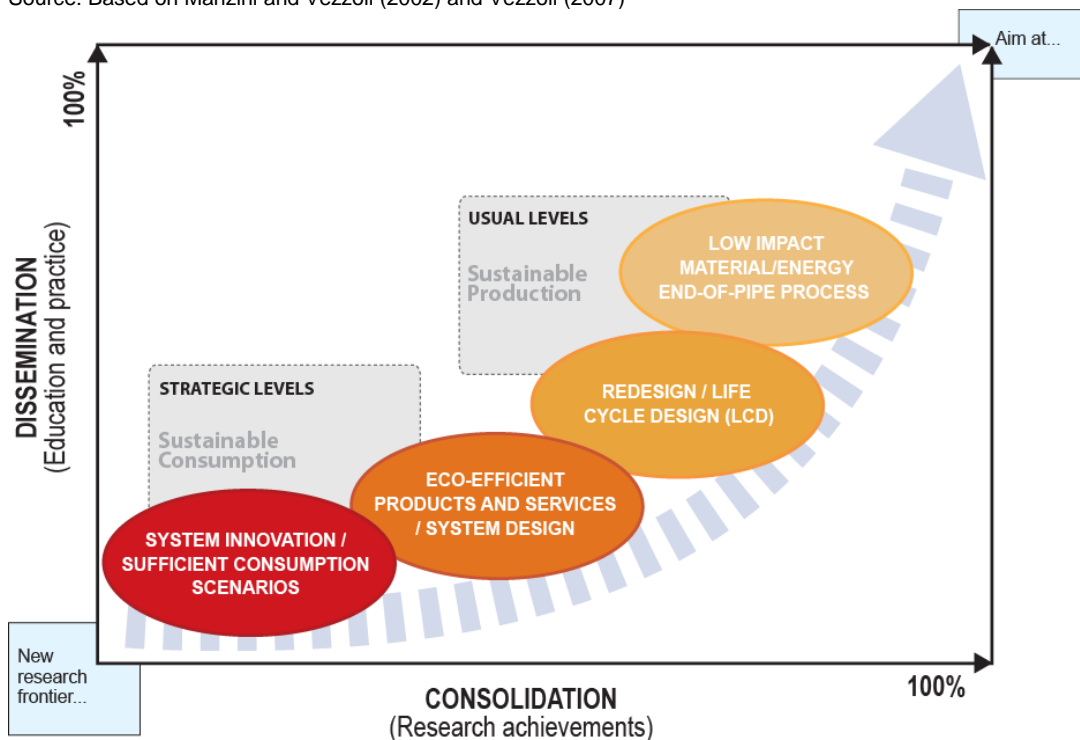
The categories of design for environmental sustainability presented in the literature (Manzini & Vezzoli 2002; Vezzoli 2007; Sherwin 2004) are basically organized as:

- a) Environmental improvement of the flows of processes and operations;
- b) Environmental redesign of existing products;
- c) Design of new products / services inherently sustainable;
- d) Systems Innovation

It is important to highlight that, as Vezzoli (2007) argues, the transition to a sustainable society requires a long and complex process of collective learning, in which (in addition to the designer's contribution) each social actor will play an important role, acquiring new skills and assuming new responsibilities. Moreover, the author defends the validity of the role of the research in design for the production of educational systems, tools and methods directed to a new generation of educators and designers, enabling them to tackle more effectively the transition to a sustainable society.

Under these circumstances, Vezzoli (2007) presents the current state of development of the new dimensions of design for sustainability, according to its levels of consolidation and dissemination. The levels of consolidation arise from the results of design research, and the levels of dissemination arise from practical actions, comprising the education and research on subjects represented in Figure 1.

Figure 1: Levels of design for sustainability (spreading and consolidation)  
Source: Based on Manzini and Vezzoli (2002) and Vezzoli (2007)



## **Environmental improvement of the flows of processes and operations**

According to Epelbaum (2004), the management of products and processes (so-called end-of-pipe technologies) and environmental certifications were firstly implemented during the 1960s and 1970s, as immediate solution to fulfill the more stringent environmental requirements.

Epelbaum (2004) also notes that from the 1990s, researchers and institutions began to support the change from technological standards to cleaner technologies, linking this factor of change to technical advantages, public policies, business practices and to economic interest.

Since then, several countries included this procedure as a legislation standard, but in the case of countries of late industrialization (such as Brazil) this procedure is not yet satisfactorily spread, due to a large structural heterogeneity among the productive sectors, which accentuates differences in technology standardizations (Young 1998).

## **Environmental redesign of existing products**

Procedures focused on environmental management of products began around the 1970's, but were restricted to academic studies of a group of designers who promoted advanced ideas and concepts, but without widely achieving the industrial sectors.

Currently, this category is divided in two different aspects: focus on the product, by redesign and ecodesign, and focus on the life-cycle analysis (LCA). Such interference in the project might take different levels of performance on the requirements of environmental sustainability, and might vary from the reduction of materials, reuse and biocompatibility to the minimizing of environmental impacts arising from the evaluation of all phases of product lifecycle. In this context, there is no profound change in lifestyles and consume practices, but design can influence consumers' choices by starting a path to sustainability, as stated by Manzini and Vezzoli (2002).

It is possible to observe that these categories are already in a good level of consolidation in regard to the conduction of researches on the topic (Lewis et al 2001; Manzini & Vezzoli 2002; UNEP 2004), but there is indeed still a small level of dissemination in practice. The driving forces for a broad dissemination of these procedures would be public policy, legal requirements and the responsibility of manufacturers for the product lifecycle. Nevertheless, in various countries, such as Brazil, for instance, these regulations still need to be strengthened by the government (Epelbaum 2004).

## **Design of new products / services inherently sustainable**

This design dimension aims at providing products or services radically consistent with the perspective of sustainability, besides being socially acceptable and able to promote cultural and behavioral changes.

In order to achieve these goals Mont (2000) states that the challenge is to cross the boundaries of traditional concepts to achieve the goals of Factor 10, or increasing in 10 times the eco-efficiency of the production process, reducing the pressure on the environment. In such cases an environmental policy integrated to the product can be a tool for consumer information, improving decision-making while encouraging the production system to develop sustainable goods and services.

To act in this level it is necessary, according to Manzini and Vezzoli (2002), to enable the production system to match the expectation of social welfare, working at the level of consumer behavior. With this objective, the designer should involve the users in the process, making them "co-creators" of solutions, once the knowledge related to the daily practices is essential to the development of appropriate solutions and important to the acceptance of proposed solutions.

## **Systems Innovation**

The term "Innovation system" or "Eco-efficient system design" have been widely used in scientific discussions in recent years, as synonym for a more precise interpretation of sustainability. Vezzoli (2007) considers that this new dimension of design refers to profound changes in patterns of consumption and production and in current lifestyles, as it goes beyond the scope of the product, focusing on the entire system of demand, promoting the new models of consumption.

Although the debate on innovation systems is broad and still in development, design researchers relate it to the term "Product Service System" (PSS). In this case, the PSS is presented as an extension of the scope of design activity, as it is characterized as the result of an innovative strategy that gives greater emphasis to the use of products and services able to fulfill the required demands (Vezzoli 2007) without necessarily involving the purchase of physical products.

As claims Manzini (1994), to act as strategic agent in this level, the designer should develop their proposals by constantly assessing environmental implications, as well as different solutions (technical, economical and socially acceptable). According to the author, only exemplary actions of the designer are not enough to the success of a project at this level of interference. For that to occur, there must be a satisfactory inter-relationship between the spheres of decision, whether political, business related or social. As Tischner and Verkuil (2006) argue, this process needs to be started immediately, first in local scale and, in the future, in a global scale.

### *Product Service Systems*

Presently, the concept of PSS can be defined as an innovation system that transfers the focus from the acquisition of products to the use of products and services. Products and services are combined in a system that, according to Baines et al (2007), has the goal of providing functionalities and generating the required user satisfaction, so that the impact on the environment is reduced. Thus, PSS can be considered as an alternative business model capable of directing the focus to the satisfaction of needs, as well as to the offer of experiences to the users, providing integrated solutions of products and services (Tukker & Tischner 2006).

To Halen, Vezzoli and Wimmer (2005), products and services have always been interconnected, because the supply of services involves a number of tangible elements, and the supply of products comprises a production and distribution network, which includes many services. In this sense, according to the authors, the main feature of PSS is this change of focus from selling the product to a mix of services, moving from a basic resource of production to a system of knowledge, in which every commercial activity aims at catering for the users' demands. To Verkuil and Tischner (2006) the greater differentiation of an innovation model based on PSS is an effective transformation of socio-cultural behaviors and patterns of use. This is due to the fact that this kind of system combines several heterogeneous elements such as cultural aspects, people, technological artifacts, organizational changes and new technologies.

By adopting PSS strategies, companies are able to improve their position in the value chain, increasing the value added to their offers and improving their innovation potential. (Tukker & Tischner 2006). In developing economies, such as Brazil, the dissemination and application of the concept of product-service systems may be especially promising. As stated by Verkuil and Tischner (2006) peripheral countries have a great potential for the implementation of new systems, since this concept includes strategic opportunities for a development based on sustainability requirements.

One of the key concepts in PSS is the dematerialization of consumption and of the amount of goods produced (Jelsma & Knot 2002). According to Baines et al. (2007) "dematerialization" refers to the opportunity that PSS offers to break the link between the value offered to the customer/user and the physical amount of materials needed to create this value.

Another important idea in PSS is the optimization of the performance in each lifecycle phase. To optimize the use phase, two strategies may be applied. The first one is to intensify the use of products, which enables a reduction in the amount of products used in a particular time and place (Manzini & Vezzoli 2002), consequently reducing the amount of manufactured products, resulting in a greater efficiency in the use of resources and a lower environmental impact (Mont 2000). Increased durability, or lifespan expansion, is the other possible way to optimize products lifespan, as explained later in this paper.

As Mont (2000) states, in order to investigate the feasibility of optimizing the product use it is firstly necessary to compare the environmental costs of the use phase to the costs of production phase (including the activities of post-production, collection, reuse and remanufacture).

When a PSS is implemented, there is a change in the traditional roles between producers and consumers, as the functional unit ceases to be the "product" and becomes the "function" of

the product. In this case, the supplier / manufacturer generally keeps the responsibility for the product during the use phase and is incentivized to reduce costs associated to this phase, including the costs of supplies and auxiliary products, as well as the cost of maintenance and upgrading services. Therefore, the cost of the use phase becomes the main concern, in contrast with the traditional models that emphasize the cost of purchasing the product. (Mont, 2004).

When the product property is kept by the manufacturer, besides the optimization of use, an improvement of product design may occur, since the producer has the opportunity to develop a better understanding of its performance (Alonso 2007). In a PSS, products become a capital worthy of maintenance, similar to the production equipment. The company begins to manage the lifecycle of the product, partially or totally, and it becomes advantageous to the productive sector to ensure the use functions of the product as long as possible. Thus, it becomes interesting to introduce incentives in the system in order to increase the product durability, adaptation, reuse and renewal (Mont, 2004).

#### **4. Implementation of PSS strategies addressed to the development of durable products**

As mentioned before, the application of Product-Service Systems provides a shift of focus from the acquisition of artifacts to the use of products and services able to cater for the existing demands. In this scenario, the possession of the product is in general kept by the producer, which can generate an optimization of use and an improvement in product design, also being possible to promote the “dematerialization” of consumption.

It is highlighted, however, the difficulty of implementing such systems, due to the need of a great cultural change, in terms of lifestyles and consumption, and also due to the psychological nature of ownership. To Chapman (2005), possession is an innate human need, linked to issues of individuality and personal expression, and, as inferred by Kazazian (2005), it is enhanced by the relatively ease access and by the desire of closeness and freedom of use. From this perspective, it is considered that the possession of certain goods would probably continue to exist even in a functional economy. Furthermore, such goods, being more durable, could provide better socio-environmental performances.

It is argued that, facing the conflict between dematerialized consumption and the possessive characteristic of humans, extending the lifespan of products, based on a deeper post-sale relationship between producer and consumer, could be a plausible intermediate solution, affording the possession of more durable artifacts. (Chapman 2005).

In this sense, producing durable goods would contribute to different solutions focused on PSS strategies, considering those in which the product is kept by the manufacturer (considered to be more radical), and those in which the product possession is kept by the final user.

In this context, it is proposed the offer of a mix of durable products associated with services as an alternative to optimize the use and to reduce the consumption of goods, taking into account that the provision of services of maintenance, exchange, lease, upgrade, remanufacture and final disposal, including the management of the entire lifecycle of products / services. This mix, therefore, can increase the profitability and competitiveness of companies in the long term, also allowing users to keep the possession of their products.

However, the development of durable products also represents a challenge, starting with its apparent contradiction with the economic interests of capitalist companies. According to Mont (2008), mass production, characteristic of the current economic system, ends up reducing prices, which leads to a growing demand for products. Thus, the companies in this context have no interest to produce long-lasting artifacts, since they consider that the sooner a product becomes obsolete, the sooner the consumer will buy a new one. In general, these companies also see little advantage in reducing maintenance costs, since consumers are responsible for the maintenance of the products they have. The repair of products is also little attractive to producers, because it is usually easier to produce new goods than to repair old ones.

Thus, according to van Hinte (2004), the development of durable goods demands not only a much broader vision from the designers, but also the adequacy of this concept throughout the production process and to the businesses needs. For the production of a conventional object, manufacturers need to make a series of investments in design, production process, machinery,

packaging, logistics system and marketing plan, among others. The process of production and maintenance of the product on the market is usually expensive, and its sales have to counterbalance such investments, and, if possible, cover the development of the next generation of products. The successor product should replace the original one, and therefore companies usually consider that it is interesting that it does not last long. (van Hinte 2004).

As a result, the major part of current products is designed to meet the objectives of an economy based on mass production, standard quality and short lifecycle. The development, production and maintenance of durable goods demand considerable changes throughout this system, in a complex process involving planning and new strategies, as well as the participation of the several actors of the production and consumption chain. Thus, this process includes the analysis of the entire period of extended use of the product, considering maintenance, repairs, upgrades and other after-sales services. (Chapman 2005).

It is possible to observe, therefore, that making a product more durable demands not only efforts of the designers but also of the producers, the marketing and communication people, the service providers and, of course, of the users and consumers. (van Hinte 2004).

The adoption of interdisciplinary approaches and education on sustainability is also relevant in all chain, including development, production, representation, regulation, distribution, advertising, commercialization fields, amongst others, in order to promote sustainability in all its dimensions.

In spite of all challenges and apparent contradictions within the dominant economic model, Kostecki (1998) suggests several reasons that might motivate companies to produce more durable artifacts. Firstly, the author argues that it is possible to observe a saturation of the rich countries markets for some types of goods. This situation is forcing companies to look for new markets or to develop offers of innovative products. In this sense, offering services associated with products, including those related to their durability, and assuming greater responsibility for their use and disposal, become interesting business strategies.

In this context, according to van Hinte (2004), a durable artifact becomes more than an object, presenting itself as a set of planned conditions, so that the product and its manufacturer are ready and committed to respond to certain circumstances. This plan would involve, for example, financial arrangements to ensure the product lifecycle, including long-term guarantees that would need also the users' commitment to maintain and take good care of the product.

The company would then offer a range of services directed to improve the process of using the product, including maintenance, monitoring, transport, upgrade and repair, which must be carefully designed and organized (van Hinte, 2004). This kind of strategy has been proved to be profitable in many fields of industries, such as the automotive one, where after-sales services are a very lucrative business, including the sale of insurance, maintenance services and periodic technical control.

Thus, even if the profitability of manufacturers decreases with the sale of more durable goods, their profit as service providers can increase significantly (Mont, 2008). Furthermore, the provision of virtual or remote services, such as online support and updating programs, allow producers to remain globally active, also providing a direct access to customers and the elimination of intermediary costs of distribution. (Stahel 1998).

Mont (2008) also indicates that the present value of the company might also increase, since investors systematically classify the companies that provide services better than those which sell products. This occurs due to the higher rates of return on equity in services, in comparison with those of production, in the contemporary economy.

Kostecki (1998) lists a few more advantages of marketing more durable products, as the opening of new business opportunities, the possibility to increase client satisfaction and the strengthening of partnerships between producers and consumers, based on trust, interaction and mutual commitment. This partnership, according to van Nes, Cramer and Stevels (1999), could encourage brand loyalty and a greater connection with the consumer, which, for Chapman (2005), directly influence the intensity and longevity of the relationship established with the company.

Besides these potential benefits, the sale of durable goods, associated with the provision of services, meets the growing social pressure in relation to environmental protection, resulting

both from the laws and regulations and from the demand of customers (Kostecki 1998). According to Muis (2006), there are niche markets that have specific demands for more durable products. These markets are formed by consumers who are tired of always chasing the latest developments, and also by those who do not give much importance to fashion and trends, seeking for artifacts more based on their personal taste and individuality. There are also those consumers who value strength and quality and that, with the growing concern with the environment, tend to look for more durable products.

Kostecki (1998) also argues that a company that becomes a leader in the optimal use of products can encourage the implementation of stricter laws, and encourage pressure groups to favor this strategy. Thus, the company invests in leadership, which can enable the sale of its know-how to the market, for example, through the provision of advice to companies wishing to implement strategies for optimal use.

However, as Kostecki (1998) points out, to obtain profit from the sale of durable goods involves complex systems, in which it becomes necessary to link management performance and product design associated with product-service systems, considering also issues such as pricing policy, distribution, promotion and advertising. According to the author, selling the durability of the products means to inform and cultivate the trust of consumers, who would feel safer by knowing details of the composition, performance, security and the commitment of the company in relation to the its products.

In this scenario, the exchange of information between users and producers is therefore essential. However, the communication associated with the durability of products presents some challenges. One of them is to identify the best ways to inform the public about the product, its durability and associated services. Furthermore, it is necessary to explain the durability to consumers in terms of its functional benefits, financial, symbolic and socio-environmental. Finally, it is also important to make the promise of durability credible to the consumers, by means of supplying extended warranties, for example. (Kostecki 1998).

Van Hinte (2004) also infers that updates and improvements, within a long process of evolution, require a different type of commitment, with less emphasis on the identity of the object. Thus, the focus is on activities related to the identity of the artifact, and in the very process of change, which results in new forms of communication and advertising.

Currently, marketing efforts tend to focus on convincing consumers to buy and on getting immediate profits. Sales of durable goods require a change in attitude of the professionals in this area, since the communication will be continuous, even after the sale. It is no longer about selling dreams, but extending these dreams, year after year. (van Hinte 2004).

For that, van Hinte (2004) suggests the creation of "mythologies", maintained and fed by the marketing, throughout the period of prolonged use of the product. There is little experience on that type of communication, which involves the planning and forecasting of the myths that may keep the image of the product stable in future scenarios. However, according to the author, it is possible to imagine the use of news and narrative sequences, involving the product in order to promote its identity and encourage prolonged use.

In this context, according to Chapman (2005), artifacts could become points of dialogue, creating links between producers and consumers through constant conversation about products and services. Such dialogue would make possible the continuous generation of profit and return to the company, even long after the sale of the product and without the need of, for example, added costs of production, extraction of resources and energy consumption. Moreover, this new scenario would involve a profound change in corporate culture, where single sales are replaced by the management of relationships.

Another important issue to consider, regarding the feasibility of marketing durable goods, is the cost. It is very important to identify whether consumers are willing to pay more for sustainable products and to find out in which categories of products the durability would be considered a decisive attribute. According to Kostecki (1998), determining the price of durable products is a similar process to the formulation of an insurance premium, based on a probabilistic assessment of future costs and benefits related to the use, maintenance, transport and possible re-marketing or resale of the product.

Therefore, the initial cost of purchasing durable goods tend to be higher, because, as indicated by van Hinte (2004), the low prices currently on the market, besides contributing in

some measure to expand access to consumption, do not reflect the real value of the artifacts. Furthermore, the author argues that the practice shows that raising the price of things can reduce considerably the waste of material. As an example, he cites the implementation of fees for the use of plastic bags, which in some countries led to a reduction of approximately 80% in the amount of bags used. Thus, besides increasing the actual cost of the products, the charging of fees can be an important governmental contribution to increase its lifespan and to transfer environmental costs to the market.

However, it is important to consider that often more environmentally suitable products are regarded as too expensive for the market and, therefore, end up failing (Mont 2008). Thus, the communication and education of the consumers becomes crucial. As stated by Woolley (2003), to be effective, strategies to increase the durability of the devices require considerable cultural change in the context of consumers and producers, with a reassessment of the value of commercial indicators such as brand strength and environmental credibility, as well as the user satisfaction throughout the extended lifecycle of products.

Thus, significant changes are needed in order to overcome the traditional inertia of most actors involved in the production and consumption processes, so that it would be possible to develop, accept and adopt new products and services and new uses (Mont 2008). Furthermore, in order to make possible the promotion of more durable products, by using innovative marketing strategies and / or public policy, it is very important the analysis of empirical data on the perception of people on the lifespan of the products and about their motivations for the acquisition, maintenance and disposal of artifacts. (Cooper 2004).

It also important to consider that in countries with peripheral economy such as Brazil, a significant average of the population lives in extreme poverty, excluded from the consumer market, which is one of the crucial problems to be solved in the search for sustainable development. In this context, the application of PSS in the developing economies can offer several advantages, since the rates of consumption and production in these countries have increased relatively fast.

## **5. Final considerations**

This paper emphasizes that design has broadened its scope of action in accordance with the requirements and needs of the current development model, and, in this sense, it is necessary to guide actions, in order to make it possible to raise the degree of consolidation and dissemination of the design for sustainability.

In this context, the PSS is a special case of service design, as it values the active performance or the use instead of the ownership, and achieves differentiation through the integration of products and services, providing value of use for the customer. However, simple applications of PSS in any of the stages of the project may not deliver expressive and automatic results in relation to sustainability, and PSS is often used from the viewpoint of improving the business itself, without focusing on the environmental improvement.

PSS has a great potential for the integration of sustainability requirements in all stages of the system design. Nevertheless, detailed investigations are needed on the possible "rebound effects", on tangible and intangible values, on approaches addressed to reduce risks, location, apply and strengthening of the control system on uncertainties, regarding the implementation of this new design category.

For it to become possible a greater consolidation of the involvement of design in the expansion of the systemic solutions, it is needed a broadening of the designer's skills to new domains. These include the analysis of the technological potential, the investigation of users' culture, behavior and attitudes, the interpretation of emerging social models, and the translation of these models in a tangible and consistent set of requirements that may direct the future applications of PSS.

To have an effective implementation of new systems that promote more sustainable lifestyles it is possible to observe that there is still a fairly wide path to be covered, because although there are several studies about this issue, there are still gaps in the implementation of this concept in practice. Thus, an important contribution to the design of product-service systems would be the connection between the technological-productive and organizational

dimensions and the cultural and socio-environmental dimensions, since from this perspective design field might cover the production and consumption systems, being able to turn itself into a key agent for the dissemination of innovation systems.

As stated before, it is suggested that the supply of durable goods associated to services and based on the PSS requirements is a plausible intermediate solution to the process of transition to cultural and socio-environmental friendly models of consumption. Thus, it would be possible to promote the profitability and competitiveness of the companies, allowing users to maintain absolute possession of their artifacts, all along the period of cultural transformation of patterns of production and consumption, in order to achieve sustainable models.

It is worth mentioning that the development, production and maintenance of durable goods is a complex process that demands substantial systemic changes, also in relation to the involvement of the several actors of the production and consumption chain. It is necessary to take into account that the extension of the durability of products include the need for design strategies focused on the entire chain of production, use, consumption and final disposal, which can include the use of materials better suited for aging, the use of more robust structures, the reduction of the functional specifications, the use of modularization, as well as the possibility of customization of artifacts, for example.

Finally, it is important to consider that while the production system can already identify new directions focused on systemic solutions, it also have methodological and conceptual limitations, since it involves relatively new concepts in the context of research and practice. These proposals are also characterized by the tension between the economic and cultural diversity, as well as the present and emergent environmental limits, and, therefore, they are still in transition, demanding deeper investigations.

## 6. References

- Alcott, B. 2008. The sufficiency strategy: Would rich-world frugality lower environmental impact? *Ecological Economics*, 64, pp. 770 – 786.
- Alonso, M. P. 2007. *Product service system: benefits and barriers*. MSc Thesis. 105 p. School of Applied Sciences. Cranfield University. London, UK.
- Baines et al. 2007. State-of-the-art in product-service systems. In: Proceedings of the Institution of Mechanical Engineers, Part B: *Journal of Engineering Manufacture*, 221, 10 / 2007. London: Professional Engineering Publishing.
- Bastos, C. 2008. Consumo de bens duráveis aumenta por causa do Bolsa Família. In: <http://www.mds.gov.br/noticias/consumo-de-bens-duraveis-aumenta-por-causa-do-bolsa-familia>. 08/04/2008.
- Becker, G. S. 1962. Irrational Behaviour and Economic Theory. *The Journal of Political Economy*, 70, pp. 1–13.
- Besch, K. 2004. *Product Service Systems for Office Furniture: Barriers and Opportunities on the European Market*. 105 p. Thesis for the fulfillment of the Master of Science in Environmental Management and Policy. Lund University.
- Braungart, M & Engelfried, J. 1993. *The Intelligent Product System*. Bulletin EPEA, Hamburg, v 36.
- Capelini, M. 2007. *Potencialidade e aplicação da prevenção de resíduos de embalagens: abordagem sobre o projeto do produto e o consumo*. Tese (Doutorado em Ciências da Engenharia Ambiental). Escola de Engenharia de São Carlos, Universidade de São Paulo.
- Chapman, J. 2005. *Emotionally Durable Design: Objects, Experiences & Empathy*. London: Earthscan.
- Cooper, T. 2004. Inadequate Life? Evidence of Consumer Attitudes to Product Obsolescence. *Journal of Consumer Policy*, 27, pp. 421-449.
- Cooper, T. 2005. Slower consumption: Reflections on product life spans and the “throwaway society”. *Journal of Industrial Ecology*, 9, 1-2, pp. 51-67.
- Epelbaum, M. 2004. *A influência da gestão ambiental na competitividade e no sucesso empresarial*. São Paulo. 190f. Dissertação (Mestrado) – Departamento de Engenharia de Produção, Escola Politécnica da Universidade de São Paulo.
- Giarini, O. & Stahel, W.R. 1989. *The Limits to Certainty, facing risks in the new Service Economy*. Dordrecht, Boston, London: Kluwer Academic Publishers.

- Goedkoop, M., Van Halen, C., Te Riele, H. & Rommers, P. 1999. *Product Service-Systems, ecological and economic basics*. Report for Dutch Ministries of Environment (VROM) and Economic Affairs (EZ).
- Jackson, T. 2005. Live better by consuming less? Is there a "double dividend" in sustainable consumption? *Journal of Industrial Ecology*, 9, 1-2, pp. 19-36.
- IBGE - Instituto Brasileiro de Geografia E Estatística. 2000. *Pesquisa Nacional de Saneamento Básico*. Rio de Janeiro.
- Jelsm, J.; Knot, M. Designing environmentally efficient services; a "script" approach. *The Journal of Sustainable Product Design* 2: 119-130. Kluwer Academic Publishers. Holanda, 2002.
- Kazazian, T. (Org.). 2005. *Haverá a idade das coisas leves: Design e desenvolvimento sustentável*. São Paulo: Senac São Paulo.
- Kosteckl, M. (Ed.). 1998. *The Durable Use of Consumer Products*. Dordrecht: Kluwer Academic Publishers.
- Lewis, H., Gertsakis, J. et al. 2001. *Design + environment: A global guide to designing greener goods*. London: Greenleaf.
- Lovins, A. B. 1985. *Least-Cost Electricity Strategies for Wisconsin*. Snowmass, CO, Rocky Mountain Institute.
- Manzini, E. 1994. Design, Environment and Social Quality: From "Existenzminimum" to "Quality Maximum". *Design Issues*, 10, 1, pp. 37-43.
- Manzini, E & Vezzoli, C. 2002. *O desenvolvimento de produtos sustentáveis: Os requisitos ambientais dos produtos industriais*. São Paulo: Edusp.
- Mont, O. 2000. *Product Service-Systems*. Final report. IIIEE, Lund University. Sweden.
- Mont, O. 2002. Drivers and barriers for shifting towards more service-oriented businesses: Analysis of the PSS field and contributions from Sweden. *The Journal of Sustainable Product Design*, 2, pp. 89–103.
- Mont, O. 2004. Institutionalization of sustainable consumption patterns based on shared use. *Ecological Economics*, 50, 1-2, pp. 135-153.
- Mont, O. 2008. Innovative approaches to optimizing design and use of durable consumer goods. *International Journal of Product Development*, 6, 3/4.
- Muis, H. 2006. Eternally yours: some theory and practice on cultural sustainable product development. In: Verbeek, P.P. & Slob, A (Eds.). *User behavior and technology development: Shaping sustainable relations between consumers and technology*. Berlin: Springer.
- Papanek, V. 1984. *Design for the real world*. New York: Van Nostrand Reinhold.
- Schmidt-Bleek, F. 1993. MIPS - A universal ecological measure? In: *Fresenius Environmental Bulletin*, 2, pp. 306-311.
- Sherwin, C. 2004. Design and sustainability: a discussion paper based on personal experience and observations. *The Journal of Sustainable Product Design*, 4:21–31. The Netherlands: Kluwer Academic Publishers.
- Souza, J. L. de. Ainda distante de um mercado de massa. *Desafios do Desenvolvimento*, set. 2007. In: <<http://desafios2.ipea.gov.br/sites/000/17/edicoes/35/pdfs/rd35not05.pdf>>. 09/10/2009.
- Stahel, W. R. 1998. Product Durability and Re-take after Use. In: Kostecki, M. (Ed.) *The Durable Use of Consumer Products*. Dordrecht: Kluwer Academic Publishers.
- Tischner, U. & Verkuijl, M. 2006. *Design for (Social) Sustainability and Radical Change*. Score! Perspectives on Radical Changes to Sustainable Consumption and Production, p. 123-139. TNO Built Environment and Geosciences, Delft, the Netherlands.
- Tukker, A.; Tischner, U. *New business for old Europe: product-service development as a means to enhance competitiveness and eco-efficiency*. Final report of Suspronet. 2004. In: <[www.greenleaf-publishing.com/content/pdfs/nbfoeparti.pdf](http://www.greenleaf-publishing.com/content/pdfs/nbfoeparti.pdf)>. 14/09/09.
- UNEP – United Nations Environment Programme. 2004. *Product-Service Systems and Sustainability*. Milano: INDACO Department, Politecnico di Milano.
- Van Halen, C. van, Vezzoli, C. & Wimmer, R. 2005. *Methodology for product service system innovation: How to implement clean, clever and competitive strategies in European industries*. Assen: Royal Van Gorcum.
- Van Hinte, E. 2004. *Eternally yours: Time in design: Product, value, sustenance*. Rotterdam: 010 Publishers.

- Van Nes, N. & Cramer, J. 2003. Design strategies for the lifetime optimization of products. *The Journal of Sustainable Product Design*, 3, 3-4, pp. 101-107.
- Van Nes, N.; Cramer, J. & Stevels, A. 1999. A Practical Approach to the Ecological Lifetime Optimization of Electronic Products. In: INTERNATIONAL SYMPOSIUM ON ENVIRONMENTALLY CONSCIOUS DESIGN AND INVERSE MANUFACTURING, 1, Tokyo. *Proceedings...* Tokyo: Institute of Electrical & Electronics Engineering.
- Vezzoli, C. 2007. *System design for sustainability: Theory, methods and tools for a sustainable "satisfaction-system" design*. Milano: Maggioli Editore.
- Vieira, I. Consumo das famílias puxa crescimento da economia no segundo trimestre. *Agência Brasil*, Rio de Janeiro, 11 set. 2009. In: < <http://www.agenciabrasil.gov.br/noticias/2009/09/11/materia.2009-09-11.5245207625/view>>. 09/10/2009.
- Woolley, M. 2003. Choreographing Obsolescence – Ecodesign: the Pleasure/ Dissatisfaction Cycle. In: INTERNATIONAL CONFERENCE ON DESIGNING PLEASURABLE PRODUCTS AND INTERFACES, jun. 23-26, Pittsburgh, PA, USA. *Proceedings...* Pittsburgh: ACM.
- World Watch Institute. 2004. *The state of consumption today*. In: <<http://www.worldwatch.org/node/810#7>>. 08/04/2008.
- Young, C.E.F. 1998. Industrial pollution and export-oriented policies in Brazil. *Revista Brasileira de Economia*. 52(4), pp. 543-562.

---

<sup>i</sup> Universidade Federal do Paraná, Brazil, [claudiazacar@yahoo.com.br](mailto:claudiazacar@yahoo.com.br)

<sup>ii</sup> Universidade Federal do Paraná, Brazil, [jucelia.giacomini@gmail.com](mailto:jucelia.giacomini@gmail.com)

<sup>iii</sup> Universidade Tecnológica Federal do Paraná, Brazil, [maristelaono@gmail.com](mailto:maristelaono@gmail.com)