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1st International
Seminar on
Sustainable
Product-Service
Systems
and Distributed
Economy

Abstract Book

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1ST INTERNATIONAL SEMINAR ON SUSTAINABLE PRODUCT-SERVICE SYSTEMS

1ST JUNE 2016

CURITIBA/PR - BRAZIL

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Foreword

It could be said that the concept of PSS is a widely present practice among the poor communities in Brazil, though not designed and not necessarily implemented with the sustainability ethos. Their lack of financial means pushed them to adopt consumption practices that includes use-oriented solutions (e.g.: shared laundry machines), result-oriented solutions (e.g.: lunch boxes produced by neighbours) and product-oriented solutions, with a wide range of services to increase the life cycle of products (e.g.: local shoemakers). On the shantytowns, the houses are tiny, requiring a more intensive share of common facilities and more intense interaction with their neighbourhood. PSS practices in such environment occurs more due to necessity than the result of a planned outcome.

n contrast, there is scattered initiatives on sustainable PSS applied within formal business organizations, a situation resulted from a lack of an effective countrywide policy to stimulate the adoption of such concept. Indeed, PSS has not been formally integrated at the "Action Plan for Sustainable Production and Consumption", where the Brazilian government has set its priorities. Notwithstanding, some of the policies presented on that document could contribute to push PSS forward, such as: the stimulus for the "Creation and Expansion of Business and Markets with Social Inclusion and Less Environmental Impact", "Sustainable Public Procurement", "Innovation and Diffusion of Sustainable Production and Consumption Technologies". Paradoxically, at the same time that there is such Action Plan, the Brazilian current economic policy focuses on the expansion of product consumption as a main development strategy, with various measures to motivate consumers to buy more goods. Industry has embraced the policy with an expansion of production capacity. Within the industry there is a natural resistance of product-oriented personnel to move beyond point-of-sale since it increases the uncertainty with gains and, at the same time, demands new competencies. Hence, the ambiguous policy set by the State policy is reinforced by conventional business strategies. In order to change such situation there is a need for governmental support to disseminate knowledge about PSS, including support for projects that demonstrate the positive implications of PSS in changing patterns of consumption and production. However, efforts to a more assertive introduction of PSS on the policies and strategies of both private and public sector in emerging contexts such as Brazil suffer from the lack of factual information on its actual benefits for businesses and regions.

Implementing PSS in the real world demands a new way of thinking about economy. In this context makes all sense bringing together the theme of PSS and the "distributed economy" concept. Brazil is a vast country where "distributed

production" of physical artifacts and services can significantly contribute with the reduction of environmental impact, particularly on the issue of transport. The transport system in the country is heavily based on the use of trucks and poor maintenance on the roads results on high costs to society with conventional approaches for centralized manufacturing. The issue of transport is also an important issue when dealing with services oriented to the Life Cycle management of products. Activities such as repairs or upgrades on products can become economically unviable due to the logistics costs. Hence, bringing producers and customers to a higher level of proximity can enable the viability of such services, opening up new avenues for a more dematerialized economy and an extension of product life cycles whenever it is relevant.

There is a growing volume of technologies that can enable small scale production, with the miniaturization of manufacturing equipments. Also, various firms (including start ups) are developing 3D printing solutions that might enable the small and local company to be competitive against centralized/high volume manufacturers. At the same time, it is clear that there is a need to develop competencies on the country regarding the involvement of customers and local actors on the Design process. Again, the geography of Brazil demands new approaches to enable this "distributed design" (ex: crowd-design). Another associated topic to Distributed Design is Open Innovation and that is quite relevant in Brazil as there is a growing community that is willing to share their solutions, guided by a sustainability ethos. Adding to that is the fact that Brazilians households are quite rich on vernacular solutions ("gambiarras") which can be a powerful source of innovative ideas.

To bring both Product Service Systems and Distributed Economy concepts into practice demands a global collaborative effort to effectively develop new didactic content at Design schools. This is the ambition of the LeNSin Project (The International Learning Network of Networks on Sustainability): a) promote a new generation of design educators capable to enable design students (the future practitioners) to effectively design and develop sustainable systems of distributed economies; b) and develop and strengthen the cooperation, between LeNS Networks HEIs and the local productive sectors via local Seminars/Courses. The proceedings presented on this document report part of the results of a two day meeting that occurred in Curitiba: a workshop at UNILIVRE (31st May) and the 1st SSPSS and DE (1st June). Have a nice reading.

Product Service System at Social Innovations Initiatives

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Abstract: The summary presents the activities and results of the Design and Social Innovation subject taught at the Federal University of Paraná (UFPR) since 2009. It starts establishing a connection between the Product Service System (PSS) themes and Design for Social Innovation, presenting the concepts taken into this article. It punctuates the method and tools used to collect cases. Later it lists the number and types of cases raised by macro categories. Finally it concludes by presenting the main difficulties and joys found in this practice.

Keywords: Design for Social Innovation, Design for Sustainability, Creative Communities, Product Service System.

INTRODUCTION

Design for sustainability has focused on the search for radical innovations, such as the dematerialization of products, offering solutions through services and the creation of alternatives for a more responsible consumption.

Among these possibilities exist Product + Services Systems (PSS), defined as the result of an innovation strategy, redirecting the focus of design business from simply selling physical products for the sale of PSS, able to meet customer demands jointly and comprehensively (Manzini & Vezzoli, 2002).

Particularly, this article deals with PSS created and managed by Creative Communities, herein referred to as Design for Social Innovation, a form of radical innovation that breaks with the hegemonic model of consumption and production through small local groups initiatives, created by individuals who voluntarily decide to get together to solve day-to-day problems in a collaborative and participatory manner, incorporating habits that can result in more sustainable lifestyles (MERONI, 2007, p. 9-15).

These people are involved, valuing their territories, restructuring the social fabric and re- establishing a new direction for the common good. These represent positive action in relation to sustainability, since responding to the three working hypotheses presented by MANZINI (2008, p. 47-51), related to the welfare and the current environmental and social crisis.

- Crisis of common goods: are goods that are shared by all and owned by no one, such as water and public places like squares and parks, but also the security and sense of belonging. These goods can not be bought nor sold, therefore they were placed outside the priorities of the hegemonic standard.

- Disappearance of slow and contemplative time: this is the time to "do nothing" or time to contemplate slowly and deeply the qualities in our lives. With the saturation of tasks and the acceleration of the actions, the reflection time has become scarce.

- Dissemination of remedial goods: are considered by the author as "products or services that try to make an acceptable living environment which is, in itself, highly deteriorated." That is, goods and services for private use and consumption that are premised on the improvement of life (new washing machines, bottle of mineral water, tourism packages, etc.). "The common characteristic of these goods is that its use or consumption does not improve the quality of life nor opens new possibilities for users" (MANZINI, 2008, p. 50).

The theme is addressed by the Design for Social Innovation and Sustainability network (DESIS, 2015), structured by schools, institutions, companies and other non-profit organizations that promote and support the research and practice on these local initiatives.

In UFPR design department the offering of subjects was chosen as a way of acting in DESIS network. Thus, from 2009 until the end of 2015, the subject of Design Systems for Social Innovation was offered six times, with a total of 64 students by 2015.

RESEARCH METHOD

For the development of activities, the DESIS project provides a "toolkit", a set of documents and power-point presentation formats, arranged in a sequence of four steps:

1. Survey of promising cases.
2. Data collection and documentation filling of the selected cases.
3. Design exercise.

In the first item, research promising cases, each group member will bring three to four cases of promising cases of creative communities to be discussed in

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the classroom with the teacher and classmates. The cases will be raised with the help of the Internet, from friends, family, neighbors, etc., based on the following criteria:

1. Innovative solutions.
2. Bottom-up organizations.
3. Socially positive.
4. Environmentally friendly.

Through data collection and completion of documentation of selected cases, the initiatives collectively approved by the group as promising will be investigated in greater depth through interviews with "communities" and visits for on-site observations.

Next, students seek to understand what are the possible contributions of the designers in these initiatives using Service Design tools for analyzing and proposing improvements.

For analysis / display of cases, the following tools and techniques were used:

• SWOT Matrix.
• System Map.
• SDO MEPSS (2016).

To propose improvements, the following tools were used:

• Customer Journey.
• Polarity matrix.
• Story board.
• Actors board.
• System Map.
• SDO MEPSS: environmental and social of the new system.
• Overview of environmental, socio-economic and ethical advantages of the new system.

The time available in the subjects not always allow the use of all tools. In some cases the improvement tools of initiatives have been suppressed.

RESULTS AND ANALYSIS

25 cases of Social Innovation were raised from 2009 to 2015. Most cases are located in the city of Curitiba and its metropolitan region. However, two cases are from Joinville, a city 132 km from Curitiba, because the students were from this city.

Listed below are the cases by macro themes:

- Mobility: Ciclo vida, Bicicletada Curitiba e Carona solidária, Caminhadas
- Observacionais.
- Creation and organization of joint public spaces: Praça de bolso do ciclista, Espaço cultural Iririú, Jardinagem Libertária, Bosque da Casa Gomm.
- Facilitate everyday life: Lavanderia compartilhada.
- Different trading systems: Moeda Social, Brechó de Trocas na UniCuritiba, Freecycle. Initiatives for the common good: Casa da Videira, PROBEM, Cursinho em Ação, InstitutoAgroEcológico, Grife Social Omunga.
- Associations: Projeto Noé, Centro Comunitário Parque das Águas Claras e Movimento de Mulheres da Primavera.
- Work: Aldeia coWorking, Solimões 541.

CONCLUSIONS

There were multiple formats in which that subject was offered: extension course, elective subject for graduation in design and master's and doctorate subjects in UFPR's PPGDesign.

Summing 45 hours/class, the subject have shown to compose a few hours to a strategic design content to which students were not used, demonstrating, mainly lack of skill with the strategic design tools. A major difficulty for the students was to manipulate intangible variables such as services.

The most motivating result for the teacher, was to realize that on contact with the initiatives the students are sensitized and often became part of or to seek ways to engage with the social innovation initiatives, understanding that the role of the designer is paramount, in communicating, managing or creating products.

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From Solid Waste to Value Innovation: Proposal for a R&D Process Based on Design Thinking, Design for Sustainability and Business Models

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Abstract: This paper presents a theoretical and methodological approach for the problem of solid waste, based on the use of Design Thinking, Design for Sustainability (DfS) and Business Models as guiding elements to achieve value innovation. The aim is to convert the solid waste in new materials and processes (technological innovation), new products (value innovation) and even new business models to deliver the innovations to the market. This proposal is part of a doctorate study, and was built both from theoretical and empirical studies of the two authors during a research project carried out in a brazilian university, between 2012-2016. The proposed research and development (R&D)

process model, that is now in the phase of evaluation and refinement, is here described and discussed.

INTRODUCTION
The problem: solid waste
This study was developed in an inductive way, in which the researchers studied a specific type of solid waste – synthetic textile waste – in order to generalize the results to build up a methodological model that could be applied to other types of solid waste. Specifically, the research object was the textile waste containing polyamide 66 (PA66), generated by Brazilian garment industries that produce clothes commonly used for fitness, sport´s practice and everyday use. Although PA66 is only the 3rd most used synthetic fibre in the world (after polyester and polypropylene), it is the most environmental impacting synthetic textile used in the garment industry. This is a relevant problem in Brazil, due to the lack of appropriate destination of PA66 textile waste when discarded by the industries or consumers. The most common destinations for this material are the donation for reuse in handcraft and sending for – sometimes not controlled - landfills. Recycling is not used, either because the technology is not available or even known, and also due to the lack of appropriate selective collect systems. Considering that these destinations and other problems are common to other types of solid waste in Brazil, the authors proposed a most general and comprehensive methodological approach that could allow to convert the problem of solid waste in value solutions, in the form of new materials, new products and new business models.

Proposed solution: Development of new materials, products and business models
As a result of a wide study and analysis done in a research project, the authors noted that, due to the amount of textile waste, neither the donation didn´t solve the problem, nor the sending to landfills or incineration were environmental friendly options. The preventive approach of avoiding the waste was investigated in the research project, but this paper focus on a corrective approach. Thus, the researchers started to investigate the strategies of reuse and recycling, incluiding the development of new materials from the synthetic textile waste. After several experiments carried out in an interdisciplinary work with Chemistry researchers, three different process for removing the PA66 from the textiles were developed, and one for melting it using high temperature. Then, these materials were used to develop new products using a typical design process, and business models were explored to investigate the market potential for the innovations. The experience obtained in this R&D project was crucial to support the development of a R&D process, started in 2015 (SAMPAIO, MARTINS, ALMENDRA, MOREIRA DA SILVA, 2015).

Solution approach: Technological and value innovation process
The R&D process here proposed combines concepts, principles, guidelines, methods and tools of three main knowledge fields: Design Thinking, Design for Sustainability (DfS) and Value-based Business Models.

Design Thinking: The concept of Design Thinking was applied in the model in two distinct ways: 1) as a mindset to solve "ill-defined" problems and explore opportunities, based on abductive reasoning (as proposed by Kees Dorst), and; 2) as an interdisciplinary, non-linear, empathic and iterative process to understand users demands, and ideate, develop, prototype and test solutions for them.

Design for Sustainability (DfS) – Life Cycle Design (LCD): In this process model, sustainability issues were considered by following the idea of product-system life cycle and its main phases (preproduction, production, distribution, usage and disposal) and five main strategies – or life cycle design strategies - that can be applied to this life cycle: minimization in the use of material, use of low impact materials, extension of the product life cycle, extension of the material life cycle and ease of dissassembly (MANZINI, VEZZOLI, 2002). Each one of these strategies are deployed in specific sets of substrategies appliable to each phase of the life cycle, depending on the product-system. Sustainability topic also included specific guidelines for the material, coming from the fields of Chemistry (Green Chemistry Principles) and Engineering (Green Engineering Principles).

Business models and value innovation (and its design): The concept of business model here adopted is strictly related to the concept of value innovation, that can encompass many types of value, e.g. functional or emotional value for the users, economical value for users and companies and environmental value for the planet. Value innovation can (and it is common) start from technological innovations, but differ from that in terms of the aim; in fact, in value innovation it doesn´t matters the technology itself, but the benefits (values) obtained when using it. So, to develop successful value-based business models, the researchers searched for a tool that could be at the same time comprehensive and easy to use, and identified one particularly suitable for their work: the Canvas Business Model, developed by Osterwald and Pigneur (2011), a visual-based tool that allow to define and visualize the main important elements of a business in an only board, using simply stick notes and pens.

RESEARCH METHOD
The basis for this study included both theoretical and empirical studies during a research project carried out in the design department of a brazilian university, using the methods of active research, ex-post facto case study, field research in garment industries, and it was complemented by the use of specific design, design for sustainability and business design methodologies, methods and tools for research and development.

PRELIMINARY RESULTS AND ANALYSIS
The R&D process model

The model (Figure 1) is structured in two main parts: the first, focused on the material, is intended to the comprehension of the problem of a specific type of waste (phase 1), and experiments with the waste (phase 2) to obtain a "protomaterial", i.e. a material with some fundamental characteristics that can be improved later, in parallel with the product and business model (phase 7).

Figure 1. R&D process model proposed.
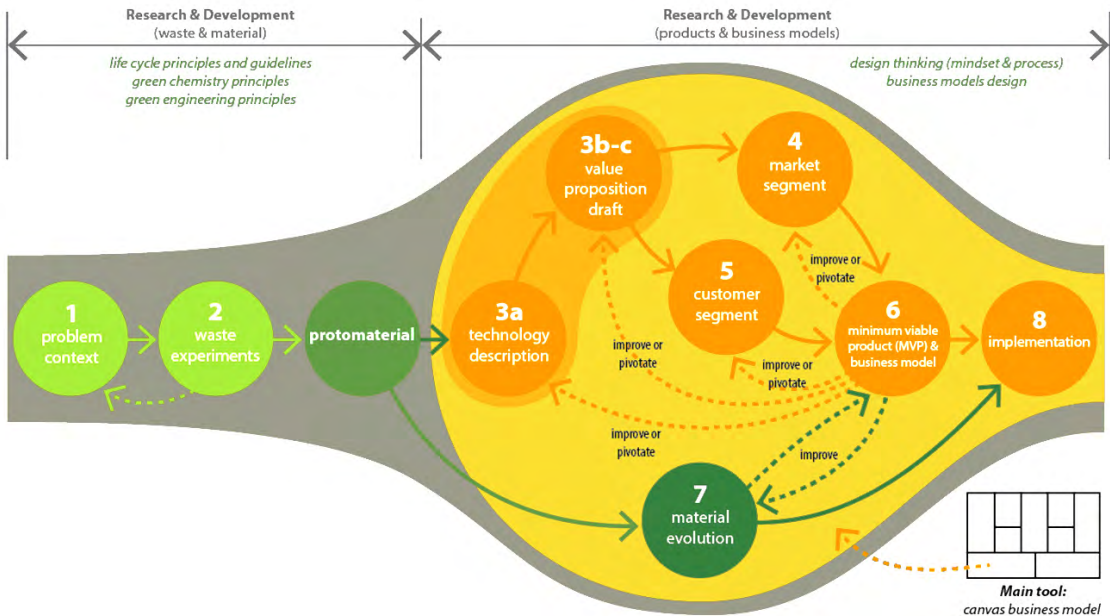
The second part is dedicated to describe the technology (phase 3a) and develop a value proposition (phase 3bc), identify and understand market niches (phase 4) and users demands (phase 5), and develop, prototype and test product and business models proposals (phase 6), that can be after implemented (phase 8). Sustainability is embodied in the process by including socio-environmental-economical guidelines (coming from Life Cycle Design strategies) and tools like SDO (a sustainability checklist) (VAN HALEN, VEZZOLI, WIMMER, 2005), in each of its eight phases.

Business Model and System Design: Business Model Canvas as a converging tool
The main tool used to guide this phase is the Business Model Canvas, that can be used associated with some complementary tools: System Map, Storyboard or Storyspot, Interaction Table (coming from Product Service System methodologies,

like MePSS (VAN HALEN, VEZZOLI, WIMMER, 2005); etnographic/emphaty tools and design, prototype and test (coming both from Design Thinking Process and Business Model Design). The "protomaterial", as a resource (technological innovation), is the starting point to use the Canvas Business Model (Figure 2).

Figure 2. Business Model Canvas application in the R&D process model.
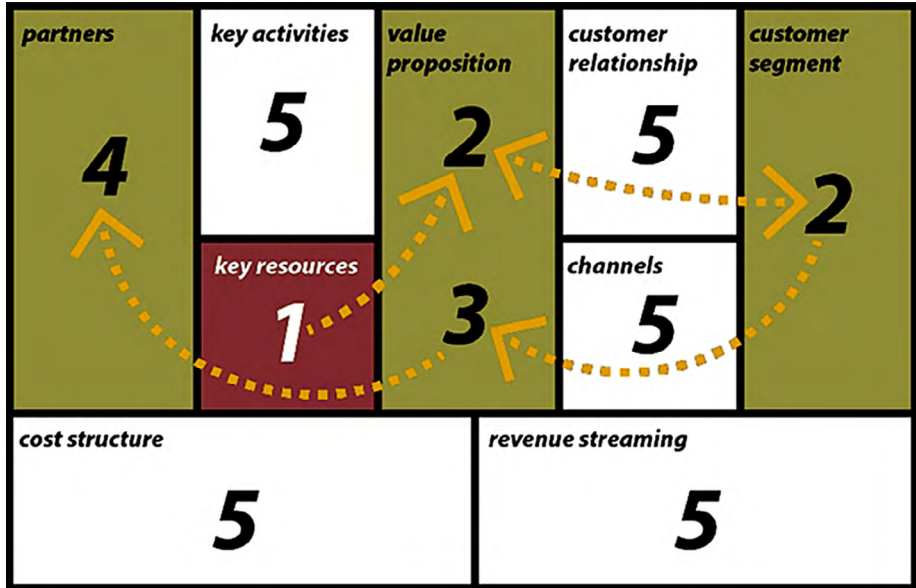
1. *Start from the key resources (protomaterial - technological innovation) SOME TOOLS: patent request / experiment reports / process descriptions*
2. *Define a preliminary value proposition and customer / user segment SOME TOOLS: value proposition canvas / desk research / field research / interviews / participant research / photo e video / shadowing / sorting card / SDO*
3. *Design, prototype and rtest a Minimum Viable Product (MVP) and Business Model with customers/user*
4. *SOME TOOLS: system map / storyboard / storyspot / interaction table / creative sessions / brainstormin / sketches / physical and virtual models & prototype / scenarios / landing page / A/B test / learning & test card / SDO*
5. *Design, prototype and test the Busines Model with partners and workers*
6. *SOME TOOLS: canvas business model / system map / storyboard / storyspot / interaction table / video / SDO*
7. *develop and detail the other aspects of the business model*
8. *SOME TOOLS: canvas business model / business plan*

PRELIMINARY CONCLUSIONS

The model here proposed is now partially being applied and tested within some different R&D teams. However, the results achieved in the research project that based this proposal seems to point to the relevance and utility of this R&D process model to address the problem of solid waste. The structure of this model demand the formation of a R&D team with specific characteristics and requirements, including a specific type of leadership, that will be explored in detail in another paper.

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Used-Oriented Sustainable Product Service System: A Case Study on Semi-Arid Region in Brazil

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Abstract: In recent years, local communities started to change their dependence on centralized public policies and began to develop bottom up alternatives to mitigate the conditions associated with water scarcity in the semi-arid region of Brazil. One case study exemplifies this bottom up approach. The One Million Cisterns Program (P1MC). The objective of this working paper is to discuss this case study in the light of sustainable Product-Service Systems (sPSS) and Distributed Economy (DE) theory, in order to validate it as a reference of sPSS and as a model of DE. The discussion aims at identifying key elements that may contribute to guideline definition for future sPSS development within the context of DE.

Keywords: use-oriented PSS, water management system, social innovation

INTRODUCTION

In the Northeastern part of Brazilian territory, a population of nearly 23,5 million people has faced for decades harsh living conditions due to severe weather. The semi-arid, a territory with an extension of almost 982.000 km2 (more than 3 times the size of Italy), is characterized for strong insolation, high temperatures and low and irregular rainfall. Shallow and rocky soils support only short or scrubby vegetation, generating shortage of water due to irregular distribution of rain and absence of underground water.

Living with the Semi-Arid presupposes the adoption of a culture of water stocking for various uses such as, human consumption, food production and animal husbandry. For more than 50 years, Brazilian policy makers did not succeed in finding a way to satisfy the basic needs of the citizens of this region. As a result, poverty and social injustice emerge as two of the main problems associated with the water scarcity in the semi-arid. The implementation of top-down solutions failed to democratize access to water supply, hindering local development, and putting individuals under economic, political and cultural domination.

However, in recent years and withinv the context of social innovation initiatives (MANZINI 2014), local communities started to change their dependence on centralized public policies and began to develop bottom up alternatives to mitigate the conditions associated with water scarcity. Based on innovative interactions between stakeholders, the process involves community members to discuss public policies aimed at combating desertification and eradicating rural poverty.

One case study exemplifies this bottom up approach. The One Million Cisterns Program (P1MC). This case offers an integrated mix of products and services aimed at seeking environmentally beneficial solutions for the communities living in the semi-arid region such as, water for human consumption in the family, schools and community centers, through diffusion of solutions such as cisterns, houses or banks of seeds.

The objective of this working paper is to discuss the P1MC case in the light of sustainable Product-Service Systems (sPSS) and Distributed Economy (DE) theory, in order to validate it as a reference of sPSS and as a model of DE. The discussion aims at identifying key elements that may contribute to guideline definition for future sPSS development within the context of DE.

THE ONE MILLION CISTERNS PROGRAM

The One Million Cisterns Program (P1MC) service began in early 2000. The service was aimed at ensuring access to quality water to families living in the semi-arid region of Brazil. Instead of a top down approach of constructing large dams, often built in private land, and stocking a volume of water for collective use, the P1MC decentralizes and democratizes access to water through the construction of cisterns for rainwater storage, which are built next to community homes. The hardware needed to run the service (hand pumps, gutters, lids, etc.), is locally made by community members or small organizations.

Through the service families get autonomy and management of their own water for cooking and drinking. As a result, the P1MC service enables advances not only for families, but for rural communities as a whole, reducing the incidence of diseases because of contaminated water consumption, decreasing the workload of women in domestic activities, and side effects such as increasing kids school attendance.

THE P1MC AS AS SUSTAINABLE PRODUCT-SERVICE SYSTEM

From s.PSS perspective, the P1MC can be considered as an integrated mix of products and services that are able to fulfill a particular user demand, based on innovative interactions between the stakeholders of the value chain, where the economic and competitive interest of the providers continuously seeks solutions with social and environmental benefits (VEZZOLI, et al., 2015).

In terms of sPSS, the P1MC service introduces relevant value propositions of innovation at different levels. First, instead of selling (only) a product it offers a combination of products and services to achieve user satisfaction. Second, it focuses on the innovation process in the stakeholder interaction level instead of focusing on technological innovation. Finally, there is a shift in the perception of value by the customer from individual ownership to access to a network of mutual collaborative services (VEZZOLI, et al., 2015).

Let's consider the first value proposition. Instead of selling cisterns in a traditional way, the P1MC offers a combination of products (cisterns, bombs, lids, strainers, etc.) and services in order to achieve the a final user satisfaction. The 'unit of satisfaction' in this case is the autonomy in the construction and management of user's water storage system. The system provides all the necessary offerings to accomplish that goal. Besides offering a water storage solution, it also includes access to financial services, training and consultancy, and collaboration from community members.

According to the second value proposition, a shift from technological innovation to an innovation on a stakeholder interaction level offers an enabling platform for customers. In the case of the P1MC, families willing to construct their water storage system register into the network to gain access to financial services to buy the materials required for the project. The network also gives access to training courses and knowledge for water management. Also, they receive the collaboration of community members in the form of labor and know-how. In exchange, families contribute to the network through donations of time, work or knowledge. It was necessary to focus the process of innovation on the interaction level o, in order to achieve the system's goals of developing a network of one million cisterns.

Finally, The P1MC shifts the value perceived by the customer form individual ownership to access to a network of mutual collaborative services. This cooperation acts on the construction of new social relations and new patterns of sociability, based on a set of values of reciprocity and sharing, complementarity and interdependence bonds. This way, trust between partners arises as a category for analyzing the cooperation between them and develops to the extent they absorb such values and fulfill the responsibilities, functions and duties set by the service partnership.

THE P1MC AS AN EXAMPLE OF DISTRIBUTED ECONOMY

What calls for attention in this case study is that the P1MC is a service run by a non-profit organization created and managed by families of the semi-arid in the models of decentralized economy. It is a flexible, small-scale production system that aims at wealth creation for a larger number of people, reinventing and prioritizing quality, and promoting collaboration and collective spirit. Therefore, the small-scale proposal of the P1MC allow for the local community to posses higher ownership and consequently gain more power in directing these systems in ways that add quality to their lives (Johansson et al., 2005).

The provision of the P1MC system relies on the organization of a decentralized network that helps families to access the service offerings. The first step is the registration of family members. This step integrates communities, families and civil society in a process of social mobilization, which guides all the pedagogical practice of P1MC. Selected families participate in a course focused on water resources management. The aim of the course is not only to train community members in the building of the tanks. It also discusses strategies of coexistence with semi arid conditions, and the importance of the cistern as a mobilizing element of rural families. After the training, families organize themselves to build their own cement board tank with the help of others members from the community. The process entails a do-it-yourself construction of a low cost cistern made of precast concrete slabs, built next their home. Each cistern has a capacity of 16,000 liters, enough water supply for an eight months period for a family of six members.

CONCLUSIONS

The P1MC success as a model of distributed economy can be attributed to the decentralized

management of resources. This management is organized by diverse networks of various

sizes, formed by grassroots organizations such as, associations, trade unions, women's groups, youth groups and other organizational forms. In this way, the service becomes also a political actor fomented and supported by distributed communities.

It is possible to infer environmental, social and economic impacts that delineate new paths towards sustainability of initiatives as the one related in this study. Nonetheless, there is a need to develop a more systematic model of sustainable assessment.

The offering of services that emerge as a result of a social innovation initiatives shows signs that there is a correlation between S.PSS applied to DE as a promising approach to diffuse sustainability in low/middle-income contexts. However, it is

necessary to carry out further studies in order to gain a deeper understanding of this hypothesis.

Finally, the designer's role is not yet defined in this kind of approach, despite the fact that the specialist point out the design activity as imperative in the developing of s.PSS applied to DE. Therefore, there is a need to define, develop and test the designer's new role to advance in current knowledge regarding design for sustainability theories and methods.

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Digital Fabrication as an Enabler of Open and Distributed Manufacturing Strategies

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Abstract: Changes on organization and distribution of information in the last two decades have created new innovation opportunities for sustainability. These are characterized by an increasing exchange of data, information, knowledge and culture on an open and inclusive way over the Internet. In this context, the present paper studies Digital Fabrication applications, which enables the use and dissemination of Open and Distributed Manufacturing strategies on the production of new artifacts. Such applications allow new modes of production and consumption that result in a positive impact on the environmental, social and economic dimensions of sustainability. In this work, a literature review (both systematic and unsystematic) was conducted in order to define the analyzed methods. By analyzing the results, it will be possible to foresee some scenarios for the use of Digital Fabrication equipment aligned with the approach of Open and Distributed Manufacturing.

INTRODUCTION

According to Gwamuri et al. (2014), the history of mass production precedes the first Industrial Revolution, initially driven by the need to equip large armies with standardized weapons. However, this centralized manufacturing structure found its means to spread globally only in the late 19th century. In terms of economy of scale, this way of producing offers great advantages for the production

costs. Among them, according to the authors, it can be mentioned savings on the purchase of raw materials, components and supplies by means of long-term contracts, technological advantages of producing in large quantities (e.g. lower energy consumption in the manufacture of a given product due to large-scale production), favorable financing conditions and access to capital and other financial instruments, the marketing and increased specialization among employees.

The conventional model for mass production also features the following characteristics:

1. increased raw-material and products movement trough greater distances, relying mainly on the reduction of transportation costs;
2. the distance between production and consumers, hiding the production social and environmental costs;
3. weakening ability for local stakeholders to have ownership and control over their immediate economic environment;
4. distortion or destruction of cultural identities;
5. limitation of diversity in regional economic activities (VEZZOLI; CESCHIN, 2008).

While we observe such implications of this predominant model for consumption and production, it is also possible to see a number of changes in the organization and distribution of information over the past two decades, which created new opportunities for sustainability innovation. These are characterized by an increasing exchange of data, information, knowledge and culture on an open and more inclusive way over the Internet.

It is in this context that the potential to develop new ways for a more sustainable production and consumption lies, using the potential of advances in Information and Communication Technology (ICT) when introducing practices that would be unlikely or even impossible once (BENKLER, 2006). Given the recent development of these computer technologies - especially the Digital Fabrication ones, that were decisive to establish new ways to manufacture artifacts in isolated regions (GWAMURI et al., 2014) - it is important to discuss, in the academy, the ways in which these technologies can enable an overview for the use and dissemination of Open and Distributed Manufacturing strategies. This refers to the creation of value in different geographic points through the production of artifacts that use networked information and local resources. This means that both raw material and manufacturing tools are arranged in a decentralized manner, and that the final product is manufactured closely to the consumer. Part of this concept is in the simplified capability of convey networked data, allowing the replacement of supply chain materials for digital information (KOHTALA, 2014; MATT et al., 2015). In the field of engineering and operations management, Distributed Manufacturing is connected to the production planning for networked companies, seeking flexibility, agility and better consumer orientation in the production and

mass customization. This term can also refer to alternative business models and opportunities for a more socially beneficial and responsible production and consumption (KOHTALA, 2014).

RESEARCH METHOD

For this article a systematic and unsystematic bibliographic review was performed about the topics proposed, in order to build a solid theoretical basis for the understanding of the subject. The key strategies and possible gaps in the use of new Digital Fabrication technologies in product development were also contemplated. The most relevant studies on Open and Distributed Manufacturing are also present and are discussed under the aegis of authors like Johansson et al. (2005) and Vezzoli and Ceschin (2008). This procedure allowed a discussion on the current paradigms involving the design, manufacture and distribution of artifacts in view of the standardized industrial model and the possible exploitation of these topics in future publications.

RESULTS AND ANALYSIS

Digital Fabrication is a manufacturing process that involves the transformation of two or three dimensions digital drawings in physical objects using tools and technologies controlled by computer (GERSHENFELD, 2012). During the making of this article it was observed a great variety of techniques and applications of this kind, and among the most frequent are 3D printing, laser cutting and CNC milling.

The Digital Fabrication processes feature a wide range of applications in industry, being observed by Jacobson (2015) as of great potential in the launch and fast introduction of new products with higher quality and better after-sales support, resulting in a greater consistency between manufacturers and their suppliers. The use of these processes allows a company to increase its ability to find errors and add improvements with less time and money investments, responding more quickly to customer and market desires. Thereby, it is intrinsic to the Digital Fabrication the risk of negative impacts on sustainability environmental dimension. However, in this dissertation, its use is understood as an opportunity for sustainability, since it can bring more effective and efficient solutions when it comes to developing new artifacts.

According to Howe (2006), the democratization of access to Digital Fabrication machinery is the result of technological advances and the subsequent decrease in costs associated with these technologies, which formerly separated amateurs and professionals. Enthusiasts, makers, curious people and users are qualified (or have the ability to qualify) for the engagement in the product development process, especially in the open-source model. This perception implies in the effective empowerment of users, who go from a purely passive to an active role in developing solutions for themselves and their community. In this new paradigm,

the innovation modes are altered, placing individuals as co-designers focused often on the provision of their own satisfaction unit (TROXLER, 2010).

In this context, the boundaries between consumer and producer intertwine and intermediaries are transformed or disappear (KOHTALA, 2014). This alternative form of participative work is in many ways diametrically different from the design and production orthodox approaches. When compared to manual processes, Digital Fabrication promotes a greater flexibility in the building of complex geometries, enabling and streamlining the customized production. Since the object produced comes directly from a digital source, it can be modified in order to obtain a better result for the user's specific needs; in the same manner, once having the code and access to the machinery, it is possible to replicate the object as many times as desired and with a great flexibility as to location. For this reason, Kohtala (2014) argues that its use is aligned with the notion of Distributed Manufacturing. Johansson et al. (2005) defines "Distributed Manufacturing" as a regional approach to promote innovation among small and medium businesses, and their sustainable development. It can also occur between individuals or a group of individuals outside the business context. This dynamic involves the selective sharing of a flexible small-scale production and its distribution among localities synergistically connected with each other. This perspective includes an intimate relationship between social and environmental elements, establishing innovative development strategies to be reached in different regions. Because they are arranged in a network, individuals or organizations placed in distributed economies gain critical mass and other capabilities through its interconnections, initiated by their needs and local resources, with the possibility of expansion on a global scale to the extent of its development progression (JOHANSSON et al., 2005). The Distributed Production allows the adoption of other strategies focused on sustainable production and consumption like, for example, fair trade and circular economy.

Among the possibilities of the Distributed Production there are new ways to promote greater longevity for consumption products and their integration to closed production and disposal cycles (circular economy), as well as the viability of a local production, which favors the conditions and particularities of a given context. According to Kohtala (2014, p.1), the Distributed Production has "the potential to be leaner and cleaner, mitigating or eliminating the social and environmental problems associated with mass production".

CONCLUSIONS
It can be said that there are substantial reasons for the application of geographically distributed production structures. The high demand for individualized or customized products that respect the circumstances and local needs, and take the social and environmental dimensions and the efficient use of resources into consideration, requires the creation of innovative concepts to replace the

traditional structures for production and artifacts distribution. Given this, the notion of Distributed Economy involves the distribution strategy of a selected part of a production to regions where activities are being organized to support flexible manufacturing on a small scale. Through small manufacturing units connected to each other, the innovation, sustainable development, increased social diversity and quality of life are promoted, maximizing the social capital and the collective spirit (JOHANSSON et al., 2005).

As a result, the Distributed Production is a desirable scenario, particularly in the context of micro enterprises, small business and low-income communities. One of the main challenges for this last one is to balance the pursuit of social equity and welfare expansion with the reduction of environmental impact. The critical points are production stimulation and increased and unbridled consumption, usually promoted by orthodox economic policies that are oriented by oligopolies, which lead to high levels of waste and natural resources extraction, among other environmental impacts. In these instances, the purchased goods come from distant industrial areas of the community, promoting capital flight and the unequal distribution of the benefits of the production (SANNE, 2002).

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Exploring Sustainability In the Early Stages of Product-Service Systems Life Cycle: A Systematic Literature Review

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Abstract: The early phases of product-service systems (PSS) life cycle play an important role in the implementation of sustainable solutions. Sustainability must be carefully considered during PSS beginning of life, since decisions made during the early phases will impact in the other phases of the life cycle. This paper aims to analyze how sustainability has been addressed in PSS literature during the early life cycle phases, since this subject is not covered yet by other PSS literature reviews. A systematic literature review was carried out; two databases were

searched to identify relevant papers. The papers were classified into categories according to the stages of the beginning of life. The main results demonstrated that the development of new methods and tools to support the early phases of PSS development is needed, especially concerning sustainability evaluation during the design process. Furthermore, sustainability should be considered in an integrated way, and new approaches to support PSS design should go further than the environmental potential of a PSS solution, i.e. the social and economic aspects should be considered as well.

INTRODUCTION

Product-service systems (PSS) have been discussed as an effective strategy towards sustainability (Ceschin, 2013). A successful offering and realization of a PSS should encompass a life cycle perspective extending the involvement and responsibility of the provider throughout the entire life cycle from (Cavalieri and Pezzotta, 2012): design and realization (beginning of life - BOL), usage and maintenance (middle of life - MOL), and decommission (end of life - EOL). Moreover, in order to conceive and implement sustainable solutions it is necessary to address sustainability in an integrated way across PSS life cycle (Kim et al., 2015), especially taken into account the early life cycle stages. Indeed, the degree of sustainability of a new solution is largely determined during the beginning of life stage of the PSS life cycle, in which the system is designed and developed. Decisions made during BOL will impact both MOL and EOL stages. Thus, due to the importance of beginning of life stages to the development of sustainable PSS solutions, this paper demonstrates a systematic review of literature that addresses the early stages of PSS life cycle. The aim is to review how sustainability has been addressed in the PSS literature during the early life cycle phases since this subject is not covered yet by other PSS literature reviews. The goal is to summarize and take stock of the theoretical insights which have been achieved so far and to identify promising avenues for future research. The next section outlines the strategies adopted to select and analyze the publications.

RESEARCH METHODS

This analysis cover only papers in peer-reviewed journals in English language. The time frame covered articles from 1999 until 2015. Journal articles were sourced from Scopus and ISI Web of Knowledge databases. The terms ´product-service system´, ´product service system´, ´industrial product-service system´, ´integrated product service offering´ and ´integrated product service engineering´ were combined with the term ´sustain*´ to conduct the search for articles. Those terms were searched in titles, abstracts, and keywords. Firstly, after eliminating the duplicates in each database, the articles were grouped resulting in an initial portfolio of 157 papers. The titles and abstracts were then read to select papers that mentioned PSS and sustainability. It was excluded the publications focusing

only on PSS concept, business models, tools and approaches and that have not specified the connection between sustainability and PSS through the life cycle. This approach reduced the portfolio to 69 papers. After full reading the 69 papers, 43 of them were categorized as being at the beginning of life and considered for further analysis.

A process was adapted to guide the research and the content analysis (Mayring, 2003), consisting of three steps: (i) material collection, (ii) category selection, and (iii) material evaluation. The categories for the material evaluation were derived deductively, considering a life cycle perspective. The selected papers were classified in four categories of the beginning of life, based on Cavalieri and Pezzotta (2012): (i) PSS requirements identification and analysis, (ii) PSS concept generation, development and evaluation, (iii) embodiment design, detailed design, test (prototyping/simulating) and final design, and (iv) implementation and measure. The results of the analysis are presented next.

RESULTS AND ANALYSIS

The beginning of life of a PSS offering starts with idea generation and requirements elicitation. The requirements elicitation starts from the analysis of the users' needs and aims at defining a set of requirements for the new PSS. From the sustainability point of view, it is important that business, environmental and social changes should be given equal consideration in requirements elicitation to achieve the aim of sustainability; environmental and social requirements are not, however, given top level importance in the literature, as already pointed out by Vasantha et al. (2015). Indeed, only a few papers in the literature have been addressing sustainability requirements for PSS development. There are missing tools, methodologies, and systematic approaches for PSS requirements elicitation, when considering all three sustainability dimensions as well as all stakeholders involved in the offer. In addition, it is necessary to develop requirements evaluation approaches, since it is not yet a highly developed domain (Vasantha et al., 2015).

The concept development phase offers the opportunity to identify options for the provision of a more sustainable way to provide a required functionality. The literature demonstrates that some frameworks have been developed to examine existing behaviors and routines in order to identify what pro-environmental behaviors can be encouraged by design (Vezzoli et al., 2015). The exploration of the use regimes that determine consumer behavior can be helpful when investigating PSS acceptance (Vezzoli et al., 2015). These considerations may also be helpful in the concept generation stages as a starting point for analysis, but only the recent literature (mainly in 2015) has been addressing these aspects. Furthermore, evaluation plays a vital role in developing sustainable PSS concepts and the evaluation of the concepts should take into account economic, environmental and social aspects (Kim et al., 2015; Vasantha et al., 2015).

Sustainability assessment in the concept generation, concept development, and embodiment design is pertinent and helpful to support sustainability in PSS development (Doualle et al., 2016). Careful evaluation in the earlier design stages must be performed before putting a PSS design solution into practice in order to guarantee the sustainability (Chen et al., 2015), but the results show that previous studies have been focusing mainly in evaluations after the solution is developed. It is then necessary to assess and to compare different PSS business models structures as well as to compare PSS solutions with traditional products/services during the early design stages. Furthermore, the three sustainability dimensions and related aspects have not been equally addressed and evaluated in an integrated way during the conceptual design stage, especially concerning the social dimension of sustainability. Indeed, the social impact/value associated with PSS lacks clear definitions, often occupying a minor position in PSS evaluation. Off all identified publications, 28 of them address the social dimension, but mainly focusing on the consumer acceptance aspect. Moreover, the existing PSS evaluation approaches fail to assure the completeness of PSS evaluation, estimating PSS solutions from the viewpoint of a part of the stakeholders. PSS evaluation requires multiple perspectives on a case-by-case basis because PSS are complex combinations of multiple components and attributes. Life cycle assessments (LCA) for PSS solutions analysis and comparison during the early design stages seem to be useful, but this is still little discussed in PSS literature, especially concerning the social life cycle assessment (SLCA) which was identified only in two papers.

Regarding the embodiment design, detailed design, test (prototyping/ simulating) and final design phase, it is important to take sustainability principles carefully during the design as many methods described in the literature have been proposed, but it is also important to develop design methods with the aim of focusing on the changes in the broader context where the solution will be implemented. Some studies have been exploring models from the sustainable system innovation field for PSS design domain (e.g. Joore and Brezet, 2015; Liedtke et al., 2015), but this is still little deeper-discussed in the current PSS literature. Sustainability assessments of prototypes should also be performed throughout the development of PSS, so it is relevant to explore it in the context of socio-technical experiments in order to enhance the sustainability potential of the solution when it is implemented. With regard to the implementation and measure stage, there exist few publications in the literature, and those are mainly focused on the exploration of consumers' perceptions. There are also few papers that address PSS implementation challenges. This stage was identified as the less emphasized in the literature, thus is necessary to develop tools and methods to support the implementation of a PSS solution.

CONCLUSION

The successful implementation of a sustainable PSS requires careful consideration of sustainability through PSS life cycle. A number of research gaps were identified.

Those should be addressed in future works to support the beginning of life of a PSS. Firstly, it is necessary to consider sustainability requirements in the requirements elicitation phase involving the perspective of all stakeholders. Secondly, evaluation approaches that consider sustainability need to be developed to be applied during the requirements elicitation, conceptual design, and detailed design. Thirdly, the evaluation of the solutions during the early phases of design should consider all the life cycle phases of a PSS. Finally, the social dimension of sustainability also needs to be considered in the new evaluation approaches, since the literature has been focusing mainly on the environmental potential of PSS solutions and a sustainable PSS involves environmental, economic and social benefits. Thus, the development of new methods and tools that take into account sustainability issues during the early phases of PSS life cycle is a direction for future research.

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Design and Change: Increasing the Success of Sustainable Product–Service Systems Through Organizational Sciences

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Abstract: According to some reports, up to 70% of change initiatives fail in organizations, in part because there is a lack of knowledge about methods of service design and service implementation. Sustainable product-service system (S.PSS) designers also face particular problems during the implementation process. One of the reasons that cause this is because they spend more time planning and generating ideas, but devote little energy in the implementation phase. Some frameworks and concepts from other disciplines are at hand to help designers to increase the chances of success implementing S.PSS projects.

Keywords: design, implementation, project management, organizational theory, resistance to change

INTRODUCTION

Sustainable Product-Service Systems (S.PSS) can be viewed as an approach of great concern to businesses, since it can add value to the life cycle of the product, provide final results with- out users necessarily take ownership of a product (MANZINI and VEZZOLI, 2002; VEZZOLI, Ceschin et al., 2015).

However, some companies have difficulty in adopting the S.PSS because of the lack of knowledge about methods of service design and service implementation (MANZINI and VEZ- ZOLI, 2002).

Manzini and Vezzoli (2002) suggest that a starting point for organizations to take advantage of S.PSS would be changing the mentality and culture of the company,

in an incremental pro- cess. But change processes in organizations, whether in S.PSS initiatives or other cases of innovation, often have high failure rates. According to some reports, up to 70% of change initiatives fail in organizations (IBM, 2008; KELLER, MEANY et al., 2010).

Designers face particular problems during the implementation process. One of the reasons that cause this is that they prefer the stage of planning and idea generation, but devote little energy in the implementation phase. The number of methods associated with the planning stage is much higher than those targeted to execution (MORITZ, 2005; OGILVIE and LIEDTKA, 2011; STICKDORN, SCHNEIDER et al., 2011;. KUMAR, 2012; CUREDALE, 2013). The focus of designers is the "delivery" and not the "implementation" (HAMMES, 2014).

KNOWLEDGE AVA LABLE ON CHANGE MANAGEMENT
Interestingly, although the design suffers from the difficulty of implementing their projects, there is enough knowledge about organizational changes in other areas. However, although abundant, these theories of change management are rarely mentioned in books about design methods. When it comes to implementing projects, most design strategies usually only rec- ommend action plans and their schedules. For example, the world's largest reference project management, the PMBOK (2015), presents 33 processes related to execution, but only nine refer to tangible deliverables. Other processes are more concerned about updating plans and documents, as well as design requirements (MARION, 2016).

AVAILABLE THEORIES ABOUT ORGANIZATIONAL CHANGES
Some frameworks and concepts are at hand to help designers to increase the chances of suc- cess in change programs, including the adoption of S.PSS systems, as follows.

Kotter 8 steps for change
Kotter suggests five methods to deal with resistance to change while implementing new pro- cesses and ideas:

• Education – Report the desired changes and the reasons involved
• Participation – Involve potential resistors in the design and implementation of change
• Facilitation – Provide training to enable people and offer emotional support
• Negotiation – Offer incentives to change
• Coercion – Dismiss or transfer employees that can not or will not change

In his most famous article, Kotter also suggests eight steps for a change to be successful (KOTTER, 1995; APPELBAUM, HABASHY et al., 2012.):
1. Establish a sense of urgency about the need for change
2. Create a coalition leadership

3. Develop a vision and strategy
4. Communicate the vision of change
5. Empower action widely
6. Generate short-term gains (quick wins)
7. Consolidate gains and produce more change
8. Anchor new approaches in corporate culture

FOUR FRAMES

Lee Bolman and Terrence Deal (1991) argue that we must implement changes in organiza- tions taking into account four perspectives, or "frames":

- Structural Frame – Refers to the skeleton or the bones of an organization. It focuses on how to organize and structure groups for superior performance.
- Human Resources Frame – Refers to individuals and how they interact with each other to meet their needs and desires.
- Political Frame – Considers the company from the standpoint of power and conflict, as well as the dangers offered by external factors.
- Symbolic Frame – The central theme is the culture and the ability to make meaning of the organization.

RADICAL BEHAVIORISM

The radical behaviorism addresses the changes in culture, required by the implementation of S.PSS projects, as a result of changes in human behavior. The behavior is modified con- cerning their effects (or consequences). Their past consequences influence the occurrence or absence of a response and its relation to the previous stimuli. Some consequent environ- mental events make similar responses have a higher similar chance of occurrence (GOU- LART, DELAGE et al., 2015). Behavior analysis describes this through triple contingency, which involves not only the response and consequence but also the context in which they occur (GOULART, DELAGE et al., 2015).

Theory of organizations

To combat organizational inertia and make changes happen, March and Simon argue that the organization should provide resources for activities not programmed, creating independent planning units with a separate budget, detached from routine operational tasks (Lanzetta and ROBY 1956 apud MARCH and SIMON, 1958)). The implementation of new technologies is more successful when accompanied by changes in the structure, the policies and the cul- ture, all at the same time (BEER, Eisenstat et al., 1990).

Organizational Development (OD)

The OD works in 3 stages to modify organizations: recognition, change and integration.

The recognition stage implies the perception of the necessity of change, avoiding resistance. The change phase itself is the transformation of people, tasks, structures, and technology. The integration stage is concerned to evaluate the results and effect settings that are accu- rate (VECCHIO, 2012). The OD also has its change techniques such as employee surveys, the formation of working groups, sensitivity training, and confrontational meetings.

Kaizen
Kaizen teaches that changes should be made in small doses spread over long periods, often involving the entire organization. Usually, the kaizen begins with the process owner or per- son with the authority to make changes, whether a manager, an employee or the CEO. In kaizen, there is no hierarchy. Plant managers and company executives work closely with op- erators to find and implement the best ideas. The team's work is to make change happen (LARAIA, MOODY et al., 1999). While in the bureaucratic model the power is on top, in the Japanese model the employees are consulted, participating in the decision-making process.

Moreover, in the Japanese perspective, the team takes precedence over the individual. The employee knows several stages of the process, exerts different positions, getting a systemic view of the whole (PERSIAN, 2008).

Improvisational Change
The Improvisational Change Theory recognizes three types of change: anticipated, emerging, and opportunity-based.

The anticipated change is the one that was planned in advance and takes place as was ex- pected. An emerging change is one that arises spontaneously in innovation and was not planned. The opportunity-based change is one that was not planned but was purposely in- troduced during the process in response to an unexpected opportunity, an event or a system failure (ORLIKOWSKI and HOFMAN, 1997).

Games of power
By implementing a design project, the change agent will realize that within an organization there are people with different interests, which have several standpoints to see the same situations, many of them equally valid (SIMON, 1947; VASCONCELOS and PINOCHET, 2002). The different decisions taken by people with diverse interests generate uncertainty in the organization (SIMON, 1947; VASCONCELOS and PINOCHET, 2002). Cooperation between these individuals is an important problem in the change process (CROZIER, 1979; VASCON- CELOS and PINOCHET, 2002). People collaborate or not, depending on how their goals and interests will be met or if they will have more or less control of company resources. Some of these assets are essential to the functioning of the system. The people who manage these resources has more power (VASCONCELOS and PINOCHET, 2002).

When a technology is replaced or a new design is implemented, new rules and regulations are created. New skills become essential to the organization, and a new system of standards must meet the new political alliances and local coalitions. The organizational change–- such as that generated by a S.PSS project – redistributes the relevant areas of uncertainty and control of resources, causing resistance in people who feel they are losing power (CROZIER and FRIEDBERG, 1980; VASCONCELOS and PINOCHET 2002). If people do not find perspec- tives similar to those they had in the old system, they will resist to change because they feel that it is a threat to them (CALDAS WOOD JR 1999).

Actor-Network Theory
In actor-network theory proposed by Bruno Latour (2005), social relations, that come into play in the change process, are effects of networks that include human beings but also ob- jects, money, machines and the environment. This is relevant to S.PSS, since it acts on the objects and environments as well, generating effects on people.

Similar to the Activity Theory (ENGESTRÖM and SANNINO, 2010; CASSANDRE and PE- REIRA-QUEROL, 2014; GONCALVES, ZACHARIAS, et al., 2014;. VIRKKUNEN and NEWNHAM, 2015) almost all of our interactions are mediated through material objects. If these elements (machinery, architecture, clothing, texts) disappear, we lose what we call "social order." The order is an effect generated by heterogeneous media.

CONCLUSION
Although there is abundant material on design projects, planning, and organizational strate- gies, we still should bridge the gap between available knowledge on change management and design processes. The high failure index of S.PSS projects due to disregard of the charac- teristics of organizations could be reduced by including change management techniques in planning and execution processes adopted by designers.

It is worth remembering that although we have many theories about the phenomenon of change in organizations, in many cases there are not many studies that validate these studies completely. Many theories often have been used more because of their practical character than by their scientific rigor (APPELBAUM, HABASHY et al., 2012). It is necessary to confirm those theories using empirical evidence through surveys, interviews and focus groups, cre- ating "grounded theory" (WAYNE, 2011).

The validation of change management theories and their subsequent application in sustain- able product-service systems has significant potential to increase their success rate, contrib- uting to the evolution and maturity of organizations, affecting human society.

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The Dimension of Services at PSS: Evaluating the Olfative Experience Within the Servicescape.

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Abstract: the quality of the user's experience during the work period (or shift), associated to a Product+Service System (PSS) has, at the visceral perception, the dimension of a quicker impact during the experience. Among these visceral perceptions, the sense of smell is still one of the senses which shows several comprehensional gaps about its dynamics – when summoner of emotional and aesthetical issues. Under the light of Service Design, the odors can contribute with a "unit of satisfaction" to the users of the offered service in a specific servicescape. Specialized Literature shows a gap, subject to the dimension of Aesthetics of Service, where the Aesthetical of Odors is included. In this sense, the lead problem of the research aimed at the main question: how to measure visceral emotions summoned by the odors in a servicescape? The objective was to develop a specific tool, which would allow the measurement process of the visceral emotions evoked by odors in a servicescape. The research has exploratory and qualitative scopes, and was developed under the bibliographic review and a survey. The results showed that the objective tool is able to measure these visceral emotions summoned by odors in a servicescape.

Keywords: Odor Aesthetics, Servicescape, Tool Development, Service Design.

INTRODUCTION

Odors are emotions inductors, and their effects are present in every culture (Chrea et al. 2009). The average man can sense and distinguish over 10.000 different odors (Scardua, 2015). The human sense of smell is specially bounded to the taste,

and most part of what humans identify as 'taste' is, basically, smell (Ackerman, 1992; Scardua, 2015). Of the five human senses the smell is the most complex (McGinley, McGinley, 2002) – it provides 80% of the taste sensation during the feeding process and performs a very good work as a accurate sense of defense, creating a repulse reaction to bad and annoying smells (McGinley, McGinley. 2002; Scardua, 2015).

Researches (Schiffman et al. 1995; Rétiveau, Iv, Milliken, 2004) showed that experiences with odours are strictly connected to its hedonic factor, potencially able to influence one's state of mind. For instance, pleasent odors can summon positive emotions, bad odors can summon unpleasent emotions (Rétiveau, Iv, Milliken, 2004; Chrea et al. 2009). Other experiments showed that odors have effects on cognitive precess and human behave, having these effects been very similar to those provenient from other types of perceptual stimulae (Ilmberger et al. 2001; Millot et al. 2002; Chebat & Michon, 2003). Some other experiments showed that odor experiences cause physiological unbalance (skin conductiveness, cardiac frequency, a. o.), which are related to emotional reaction (Heuberger et al. 2001; Pössel, Ahrens, Hautzinger, 2005). And yet, experiences with odors can summon autobiographic memories. Emotionally intense memories, forgotten long ago (Chu & Downes, 2000; Chu, 2008). These effects are generally interpreted as interdependency issues between the sense of smell and the emotion, overlayed in the neural system (Phillips & Heining, 2002) and were confirmed by evidences of neuro-image systems (Royet et al. 2003; Herz et al. 2004). In this sense and under the Service Design lights, odors can contribute with a "unit of satisfaction" for the users of the service, offered in a specific servicescape.

Service Design adds to the project of the experience of the service as a whole, of its processes and strategy to deliver it (Moritz, 2005). Thus, Service Design shall understand the client, the organisation, the market and develop ideas that will be translated into possible solutions, and implement them. Service Design shall approach the funcionality and the way of the service issues, with two clear objectives: regarding the client, Service Design shall make sure that the service interface will be usefull, usable and desirable (Mager, 2007); and regarding the supplier, Service Design shall guarantee that these are effective, efficient and distinct interfaces (Mager, 2007). In that scope, the intention of the Service Design is to transform the service into something usefull, usable, efficient, effective and desirable.

In specialized Literature, there's a gap about Aesthetics of Services (Freire, 2011), where Aesthetics of Odors shall be included. Yet, the tools available to the measuring process of the emotions summoned by odor are very dependent of cultural questions and users recall and background. In this environment,

the main question leading the research came up: how to measure the visceral emotions summoned by the odors in a servicescape? As objective, it is intended to develop a tool, able to measure the visceral emotions summoned by the odors in a servicescape.

RESEARCH METHOD

This research has exploratory and qualitative scopes, and its development was achieved in five fases:
1. bibliographic review (RB);
2. the developing of the tool;
3. the elaboration of a M. O. to the enforcement of it;
4. try-out with the tool and 5) execution of a survey in order to use the developed tool within a specific servicescape.

Figure 01. Tool developed to measure the visceral emotions evoked by odor in the servicescape (Adapted from the original language to English).

Reference: The authors (2015).
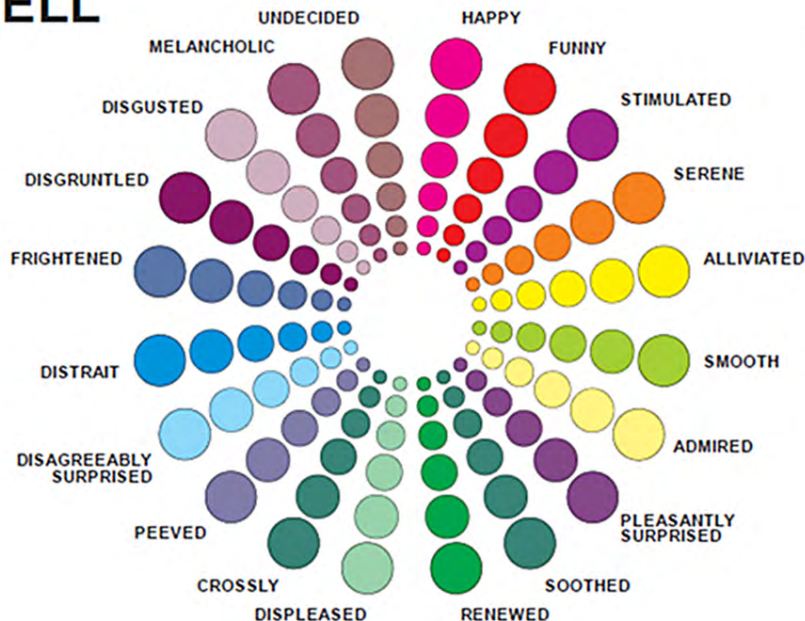
The bibliographic review was intended to delimit a scape of scientific research in the area of Service Design, aesthetics, emotion and feelings. The development of the tool was based on the studies (identified in the bibliographic review) of Chrea et al. (2009) and Scherer (2013). As the first text presents 36 descriptions of emotions, and the adopted model (GEW version 3.0 in: Scherer, 2013, p.27) was about 20, a selection was necessary. The terms were chosen according with Cronbach's alpha (>80). The next step was to group the terms by 'semantics likeness' to reduce them to only 20 relevant terms. Following, the tool's lay out was determined and created using a graphics software. The graphic organisation and the use of colors were privileged (see fig. 01). This tool can be used to record from visceral emotions felt by the user, to the visceral emotions the user would like to experience, summoned by odors in the servicescape. In Jun/28th/2015, in the dependencies of a public hospital in Curitiba, a try-out test was put in practice, with seven volunteers. Only a few steps in the protocol had to be reviewed and fixed. Between Jun/23 and Jul/11/2015, a survey was put in practice with the pacients of the same public hospital. After the test, all data was framed and analyzed according to Spearman's coheficient of correlation, and the 'signal test', for these are no-parametric statistics data.

RESULTS & ANALYSIS

During the survey period, 100 pacients answered to the test, noting their emotions and the emotions they wanted to feel, according to the odors present in the servicescape. Using the Spearman's coheficient of correlation and a significancy level of 1%, the significative correlations (p-value minor than 0,01) were noted and are present in Table 01. Note that disgust and discontent are directly correlated, showing that in the studied servicescape, the most disgusted the interviewed felt, also most was its discontentness. On the opposite, wonder and distraction show a weak correlation. Note that negative emotions show more correlation. The same does not happen at the opposite, for there are positive pairs as well: Happy/Serene and Serene/Renewed.

In order to check if there is significative difference between the degree of the felt/expected emotions, the 'signal test' was performed. When p<0,05, means that there was significative difference between what was felt and what was expected to feel. In the Table 02, in yellow, we can see the emotions in which the expectancy was bigger than what was felt. In blue, the emotions felt, but little expected. For instance: it was answered that it was expected to feel happyness, but less was felt than expected. Yet, it was felt more fear than it was expected.

Although it is not possible to generalize, since it is about non-parametric data, all data showed that effective actions shall be implemented to improve the user experience in the servicescape, for there's predominance of negative visceral emotions.

Table 01 – The correlations between emotions summoned by odor in the analyzed servicescape (Adapted from the original language to English).

Reference: The authors (2016).

	SMELL (High correlation)		SMELL (Low correlation)	
	Emotion	R	Emotion	R
1	Disgusted/Disgruntled	0,805327	Admired/Distrait	0,277448
2	Undecided/Melancholic	0,766206	Smooth/Admired	0,281849
3	Disgruntled/Crossly	0,759466	Happy/Serene	0,291843
4	Disgusted/Frightened	0,754517	Renewed/Undecided	0,292172
5	Disgusted/Peeved	0,738558	Serene/Undecided	0,297454
6	Disgusted/Croosly	0,731298	Happy/Undecided	0,301581
7	Disgusted/Displeased	0,702952	Soothed/Melancholic	0,317520
8	Undecided/Displeased	0,700564	Admired/Undecided	0,323819
9	Disgruntled/Peeved	0,691112	Serene/Renewed	0,323827
10	Frightened/Peeved	0,690984	Funny/Displeased	0,324507

Table 02 – Difference between the degree of the emotions felt and expected in the analyzed servicescape (Adapted from the original language to English).

Reference: The authors (2016).

	Emotion	R	Emotion	R
1	Happy	0,000000	2,95	4,62
2	Smooth	0,000011	2,8	4,04
3	Soothed	0,000001	2,11	3,92
4	Alliviated	0,000011	2,11	3,75
5	Serene	0,012193	2,69	3,49
6	Frighened	0,000004	1,25	0,38
7	Disgruntled	0,002200	0,77	0,27
8	Peeved	0,008829	0,71	0,32
9	Disgruntled	0,033895	0,57	0,23
10	Melancholic	0,026500	0,56	0,23

CONCLUSIONS

The results show that the developed tool is able to measure visceral emotions evoked by odors in a servicescape for the statistics tests used to analize all the data ensure its veracity.

About the emotions reported by patients, Spearman's coheficient of correlation showed that there are consistent correlations between the emotions felt. The

'signal test' allowed to check the existence of significative diferences between the degrees of emotions felt and expected. However, the tool developed has got its limitation: the need of more research aiming to check if the terms of the tested emotions evoked by odors and present in the tool are valid and relevant to the different servicescapes.

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Modu.lares Design Pilot Project: Barriers and Opportunities of Sustainable System Innovations

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Abstract: This work describes a Design Pilot Project experience developed in the city of Uberlandia (MG/Brazil) with eight micro enterprises of the furniture sector from 2011- 2012. The pilot involved multiple organizations to work in a collaborative model with the aim of achieving a more sustainable path through Design. The experience adopted the action-research method in order to permit adjustments during its course. Findings demonstrate some positive results but also the great difficulties of proposing such a complex system, where each stakeholder should play a specific role, thus sharing responsibilities, especially in a region where no collaborative practices are already noticed.

Keywords: Design Pilot Project, Collaborative networks, Furniture Sector in Brazil, System Innovation, Sustainable Product-Service System.

INTRODUCTION

This work presents some results of the MODU.Lares, a Design Pilot Project carried out in a collaborative way as a strategy to trigger the beginning of an evolution toward sustainability of a fragmented local system, with poor records on the sustainability dimensions. The pilot project was a socially and environmentally relevant network-based experience, which engaged actors with different typologies, such as: wooden furniture Micro and Small Enterprises (MSEs), the university, support institutions, local government, non-governmental organizations, associations and society as a whole. The experience occurred in the city of Uberlandia/MG, Brazil, from January 2011 to June 2012.

Regarding the furniture sector, it is characterized by tailored and craft manufacturing processes. Formed by about 800 MSEs (Oliveira, 2012), almost 85% of the firms

are not officially registered, and the majority work with old machines, with few exceptions. Most MSEs lack control over the selection and use of safe raw material as well as of waste disposal, which portrays a serious environmental problem for the city (SENAI et al, 2006; Nunes, 2013)[1].

The Pilot Project proposed a new way to conceive, to produce furniture, and to relate with other organizations aiming at achieving better results of sustainability, economic and technological issues, and sociocultural aspects (Manzini, Vezzoli 2002; Hardy et. al, 2005). The adoption of modular furniture solutions aimed at reducing raw material waste and residue as well as at optimizing time and manufacturing (Maxwell, Van der Vorst 2003; Ljunberg, 2005; Vezzoli 2007).

Organizational and sociocultural aspects were faced in order to push collaboration among companies themselves to exchange knowledge as well as to support a distributed production process. The reorganization of MSEs was essential to restructuring relationships and to manage actions, therefore making business advances (Van de Ven, 1986; Marchica 2004; Best, 2006). Besides, as the final furniture was oriented toward low income customers, beyond producing a more efficient and sustainable product, with low cost, it also intended to satisfy basic needs of this population strata (Elkington 1994; Porter, Krammer 2006; Morelli 2007; Parker, Ford 2009).

RESEARCH METHOD
The whole research developed during the PhD program was organized in three main phases: a first-theoretical phase, a second theoretical-empirical phase of Action Research (Lewin, 1946) (where the Pilot Project is inserted), and a third-theoretical final phase. The research methods adopted were: a) qualitative, aiming at grasping the context totality of those involved in the research, in order to generate broader information in an illustrative manner; and b) exploratory, to make the problem more explicit and involved: literature review, interviews with the group engaged in practice with the problem, questionnaires and case studies (Silveira e Cordova, 2009; Yin, 2009). The action research phase was oriented, on one side, to wooden furniture MSEs and, on the other, to the multidisciplinary team of stakeholders already mentioned. The pilot included: initial plan elaboration, implementation/execution, action monitoring and re-orientation of strategies (when needed), and a final evaluation of the experience.

RESULTS AND ANALYSIS
This work highlights the importance of increasing competencies and sustainability awareness for achieving more responsible practices within MSEs. Indeed, this increase depends on a radical change in the way MSEs operates, and requires

[1]In 2012, the estimated waste generated annually by these companies was about 22.000 m³ (including waste of panels, cans, finishing and other small components).

knowledge and new behavior. In general, due to work overload, often MSEs do not engage in processes to improve knowledge that could support their evolvement, and, exactly because of this, a collaborative network could help them to reach better operational levels.

However, when partners are not able to deal with internal problems, the barriers of working together as well as the potential vulnerability of relationships, mutual respect and trust among partners increase, as happened. Thus, it is critical for MSEs to recognize the need for improving both the individual levels and the company's abilities, making them part of the process by learning and sharing knowledge and information to obtain better results of design and to engage in system innovations processes.

For example, the attention dedicated to organizational aspects (thus clarifying visions about their business and more adapted paths to cover), and to technological and innovation aspects (thus exploring new ways of manufacturing, especially adopting a distributed production, even though still using craft systems) still must be reinforced and translated into the strengthening of the MSEs' management levels. Above all, the increase of such competencies must be associated with the increase of interest in facing the environmental problems that regard each MSE operation. All these aspects, if coordinated with a main collective intent, can support better interaction in complex collaborative systems, thus contributing effectively to the evolvement of the broader context as a whole.

It is therefore valuable that innovative and management strategies include the exchange of knowledge among MSEs, hence contributing to the adoption of more efficient processes through design oriented to products and services as well as contextualized solutions that respect and potentiate local cultural aspects. On the other hand, achievement of effective system innovations depends mainly on: a) the continuity of actions performed by a specific group involved in any experience; and b) the quality of knowledge shared among them. Also, maintenance of such system innovations will depend again on the quality of these relationships built on a collaborative network approach.

CONCLUSIONS

Sustainable strategies must include collaboration and exchanging of knowledge as well as the adoption of more efficient processes through design. However, for Lopes and Baldi (2009) collaborative works are not per se a synonym of system innovations and local development, but they depend on the involved group, the contexts and the mechanisms of coordination. Also, factors such as motivation, potential for innovation, environmental awareness, skilled labor and competencies, and capacity for establishing (and maintaining) partnerships can jeopardize the continuity of collaborative and interdependent initiatives. Mozota (2003) and Best (2006) affirm that the insertion of design strategies within companies depends on

the increase of strategic thinking within the organization. Actually, the outcomes validate that not every partner (MSEs or other organizational typologies) can successfully be engaged in collaborative networks, as well as positively implement system innovations, whether technical or behavioral, or related to designing products, processes or services, due to either their limited economic capacity or their owner's vision. In terms of technology, infrastructure and production, the majority of local furniture MSEs presented a low technological level which reflected in limited productivity and lack of competitiveness in a broader market. Moreover, design awareness is still quite challenging because it is not perceived as a key factor for the MSEs' operations. This highlights the pressing need for diffusion of the design culture within the sector, in order to improve both technical and systemic aspects as well as management issues.

A relevant aspect noticed during the pilot was the need to guaranty the success of any investment of time and money, before it could occur. In a few instances, only two entrepreneurs (from eight) recognized the experience either as an opportunity for both improving knowledge and creating value for their companies, or an opportunity for increasing the sustainable aspects of their operations or their competitiveness.

Despite diverse limitations, the MODU.Lares Project revealed that some partners had feasible conditions to adopt new paths and collaborate toward a new scenario. However, the strong state of passivity of the local furniture sector and other organizations (i.e., support institutions, local government) as well as political constraints also demonstrated that, notwithstanding those feasible conditions, there is a demanding path to follow. Therefore, it is decisive for the sector to recognize that innovation is not the enterprise of a single entrepreneur and that systemic operations are a strategic key to MSEs. Above all, a network-building effort is necessary which focuses on the adoption and the continued execution of a set of new ideas among organizations which, through healthy interactions, become properly engaged with these ideas in order to transform them into good and replicable current practices.

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