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PROMOTE SUSTAINABILITY THROUGH PRODUCT DESIGN PROCESS BY INVOLVING THE USER

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Abstract

The concept of the sustainable development which is defined in terms of the triple bottom line (economic, environmental and social) is becoming increasingly important. Until now, however, the social aspects have been under-investigated in comparison to environmental and economic aspects. From the product design point of view there is an emergency for development tools and methodologies that are directly linked with the social pillar of sustainability. The research has as main target to discover the future role of designers and engineers to address sustainability as well as emerging priorities from societal to environmental challenges. Furthermore, the present paper presents a model named sustainability push & pull, which is focused on the cultivation of sustainable behaviour to the citizens. The key issue is the users/citizens participation during the product design process, playing an active role to the product development. The whole work was based on a framework which was built according to the direct communication between users and designers. Focused on this target, two new design for X methodologies a) Design for Promoting Sustainable Principles through user education and b) Design for Green Usability developed following the guidelines of the proposed User Assessment Tool. The research garnered responses from 72 participants who answered detailed questions during the whole design process. Data analysis was accomplished according to the data analysis process proposed by Miles and Huberman. The positive view to the whole process made clear that the used methodologies are friendly and very interesting for both the users/citizens and designers. The results from both the questionnaires and interviews show that it is also very educating while the proportions of knowledge about sustainability were grown up.

Key words: design for promoting sustainable principles, sustainability, sustainable behaviour, sustainable user centred design practices, user research methods

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1. Introduction

The current socioeconomic systems have managed to bring prosperity to the developed countries. However, this prosperity didn't succeed to stop all the environmental issues that people are facing in today's world and to support a growing world population in combination with the need for higher standards of living, especially in the underdeveloped countries. The challenge of our generation is therefore a better system of production and consumption which

is capable to bring an economic development with societal progress without environmental deterioration and the use of non-renewable resources. Nevertheless, when the term of sustainability is used, most people's thoughts are related with the environmental protection, climate change and other environmental problems, while at the industry level sustainability is more directly linked with the economic and the environmental aspects.

Despite recognition of these other elements, the social side of sustainability has often been overlooked

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and the attention on social issues in many cases has been lost. Furthermore, there is a need for user socio-cultural transformation towards to more sustainable consumption behavior. The “user-centred” approach is the key for the development of sustainable consumption patterns and sustainable lifestyles.

Design for Sustainability is directly related to the three bottom lines: environment, economy and society and acts as an umbrella which covers all the Design for X concepts. The development of those techniques shows clearly the priorities in product development in previous years. Practically, According to previous research it is obvious that DfX has mainly focused more on Design for Environment and Economic aspects. Only in the recent years, DfX methodologies focused on the social pillar of sustainability has begun to be appeared. The social sector is ready for innovation. Moreover, classifying the DfX techniques according to the different stages of the whole lifecycle of a product, it is obvious that there is a substantial gap to the use phase. The manufacturer’s choices even in product use phase are not user oriented.

Social sustainability means when meeting the needs for human well-being sustainability (Rogers et al., 2012), it is necessary to have well-functioning societies from a socio-political and economic standpoint which can meet the new challenges successfully. Falcone and Imbert (2018) identified the main social impact categories and indicators that should be included in a social sustainability assessment of bio-based products, with a focus on the consumers’ category. They carried out a literature review on existing social life cycle studies, and after that they conducted semi-structured interviews with some consumer representatives in order to understand which social indicators pertaining to consumers were perceived as relevant. Their findings highlight the necessity for the development and dissemination of improved frameworks capable of exploiting the consumers’ role in the ongoing process of market uptake of bio-based products. Rainock et al. (2018) integrated scholarship from a wide array of social science and engineering disciplines that categorizes the social phenomena that are affected by products. They identified social impacts and processes including population change, family, gender, education, stratification, employment, health and well-being, human rights, networks and communication, conflict and crime, and cultural identity/heritage. Current research focuses to the interconnection of social and environmental sectors. It involves citizens, trying to educate them about all sustainability aspects meanwhile creating, developing and diffusing ideas for the development of products which promote societal or behavioural shifts towards a more sustainable lifestyle.

2. Conceptual and theoretical background

2.1. Design for sustainability

Nowadays the challenge of transition to a more sustainable society gives importance to Design for Sustainability (DfS). DfS goes beyond the Ecodesign or Green Design, by integrating social, economic, environmental aspects by offering opportunities to get involved in the product life cycle. Environmental standards and regulations, together with the growing expectations of customers, have made the sustainability concept crucial. Designers should not only consider environmental problems when developing a new product or upgrading an already existing one, but based on the DfS viewpoints, environmental aspects have to be balanced with the economic and societal ones, in order to achieve the goal of sustainability (Fargnoli et al., 2014; Ghinea et al., 2018; Jonker and Harmsen, 2012; Wever and Vogtländer, 2014).

Eco-design or Design for Environment (DfE) methods were developed as designer supporting tools during the product design phase (Ahmad et al., 2018; Shi et al., 2017). DfE is focused on the environmental considerations for separate product life cycle each time, while eco-design is more generic as it is involved on the entire product life cycle (Wrisberg et al., 2012). Eco-design is a method that involves environmental issues into product design and development at all phases of a product's life cycle. In order to reduce environmental risks eco-design strategies can be used by the designers for the improvement of environmental performance of products at every life cycle phase. Of course, the right combination of those approaches throughout the product life cycle leads to the design of environmentally responsible products. There is a variety of eco-design tools that are divided in two general categories. The eco-tools which perform a very intensive analysis providing specific solutions to improve the environmental performance of a product and those tools which perform a primary qualitative analysis, based on general recommendations in order to improve the existing situation (Kim and Moon, 2017; Novelli et al., 2018).

Ceschin and Gaziulusoy (2016) explored the evolution of Design for Sustainability (DfS). They classified all the developed design approaches under four innovation levels: (i) Product; (ii) Product-Service System; (iii) Spatio-Social; and (iv) Socio-Technical System. The first approach focuses on improving an existing product or in developing a completely new one and involves different techniques. These techniques are the following:

- *Green Design*. Product design should focus on reduce-reuse-recycle.
- *Ecodesign*. Focuses to the entire product life cycle, from the extraction of raw materials to the final disposal.
- *Emotionally durable design*. Explores the use-product relationship, seeking to extend the useful life cycle of the products.
- *Cradle-to-Cradle Design*. Focuses on processes that create a circular production system, in which waste must be perceived as nutrients to start a new life cycle.

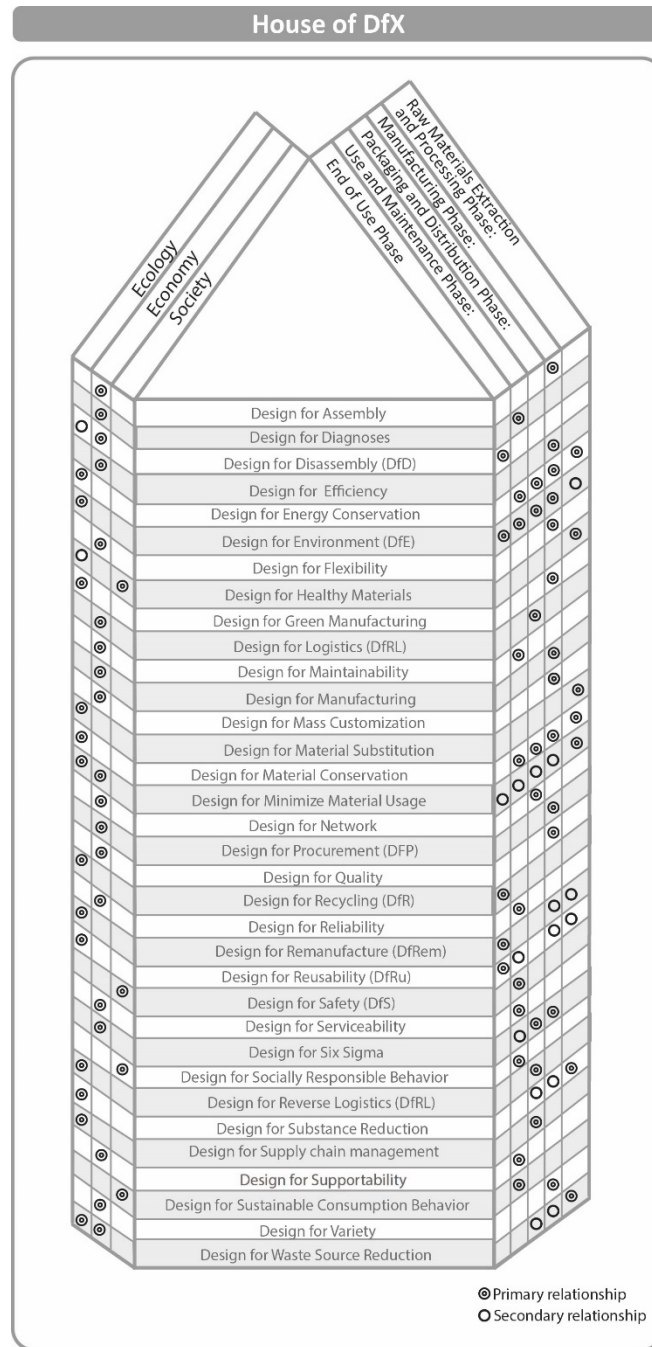


Fig. 1. Classification of Design for X methodologies according to each pillar (economic, environmental, social) of sustainability focused on the lifecycle stages of a product

- Biomimicry Design. Focuses on analyzing and copying forms and processes of nature as well as ecosystems.
- Design for sustainable behaviour. Considers the influence that users may have on the environmental impact of using products

2.2. Design for X approaches

Design for X (DFX) is a methodology which has as main target the optimisation of the processes depending on a specific area of focus (X). According to DFX the development of techniques should be

motivated and enhanced for the improvement, or even the creation of specific characteristics of a product. Basically it is a set of technical guidelines that help to the design optimization. Furthermore, the development of those techniques inspires and provides specific solutions during the whole design and development process. Initially DFX was developed based on the customer needs satisfaction and the enhancement of product competitiveness (Chiu and Kremer, 2011; Hepperle et al., 2011; Holt and Barnes, 2010; Raffaelli et al., 2010). Over the years, many DFX techniques developed on the basis of manufacturability, quality improvement and the

reduction of the cost and time to market (Arnette et al., 2014; Bonvoisin et al., 2016; Comanita et al., 2018; Rossi et al., 2016; van de Poel, 2015). As mentioned before, DfS has as main target to increase product profitability, quality, environmental friendliness and social advantages. In the current research, a number of Design for X techniques are classified under the umbrella of each pillar (economic, environmental, social) of sustainability focused on the different stages of the whole lifecycle of a product (Fig. 1).

The classification of design for X techniques indicated that most of them are related more with the economic and the environmental pillar of sustainability, while social sustainability has often been ignored. Moreover the vast majority of design for X' methodologies are directly related to manufacturing issues, even in product use phase the manufacturer's choices are not user oriented.

The user/citizen interaction with a product can easily influence its environmental impact, which means that there is a need for new methodologies, in order to emphasise the social aspect of sustainability. For this reason, designers should put extra effort in order to manage a cultural transformation, which can be focused on users and promote the needed behavioural change. Based on this gap there is a necessity for the development of novel methodologies and tools. Those should be directly related to the user/citizen. If social sustainability is not given due consideration, it often results in lost opportunities, or at worst, in negative social outcomes.

2.3. Social-Centered Design

During the whole life cycle of a product, the use phase may have the greatest environmental impact. Based on this fact there is a necessity for the development of methodologies, which would be directly connected to the use phase of the products. For example, energy consumption during the use phase of products' lifecycle has a significant environmental impact mainly influenced by the consumer's behavior. The last decade, a design methodology called User-Centered Design (UCD) (Wever et al., 2008) is under consideration with an aim to understand the users' needs, goals, and limitations. Daae and Boks (2015a) presented a review of user research methods from the User Centred Design literature. The review investigated all the factors that affect behavior in order to guide designers to find solutions which encourage sustainable or avoid unsustainable behavior. The result of the research showed methods that are suitable when investigating specific aspects of behavior.

In fact, Implementation of the UCD methodology through the user observation of practices, habits, beliefs and attitudes, let the designers to have a better view.

User Centered Design also referred to as Human Centered Design (HCD). This happens as both methodologies have many similarities, but are not exactly the same. HCD is the development process based on general natural characteristics, particularities

and individualities of human psychology and awareness.

For this reason, it is believed that the involvement of psychologists, behaviorists, physiologists and other experts into the design process is desired. According to HCD, the human needs and desires are placed at the top of the priority list during the product development process (Giacomin, 2014).

Introducing Social Centered Design (SCD) means that believing all problems, even the seemingly intractable ones like poverty, gender equality, and clean water, are somehow solvable. The people who face any problem in their everyday lives are those ones, who have the right answers. Designers should come near to the communities for achieving a better understanding of the actual needs. People's lives and desires should be at the core of the design process (Mauser et al., 2013). The social sector is ripe for innovation. Only in the recent years, DfX methodologies based on the social pillar of sustainability has begun to appear. Efforts such as the Social Impact Assessment (SIA), which has as a main objective to assess or estimate, in advance, the social consequences that are likely to follow from a specific policy actions and the Social Life Cycle Assessment (SLCA) (Benoît and Mazijn, 2009; Reitingger, et al., 2011). It intends to analyze the social impacts of a product, started the introduction of social aspects in the product development process.

2.4. Sustainability through behavior change

The increased focus in research on the environmental consequences of behaviour and product usage has resulted in the development of a number of different methods, tools, and techniques. Coskun et al. (2015) conducted a literature review by identifying conceptual and empirical studies classified them to strategies, frameworks, toolkits, and guidelines for behavior change. Zachrisson and Boks (2010) investigated when to apply different design for sustainable behaviour strategies. They developed a framework using factors affecting behavior that were identified by social psychology. Daae and Boks (2015b) investigated how Design for Sustainable Behaviour (DfSB), may contribute to the way LCA deals with uncertainties related to variations in the use phase.

Medeiros et al. (2018) assessed literature survey frameworks about Design for Sustainable Behavior and identified similarities and complementarities. They proposed a decision support diagram with questions that help designers to guide the whole process. The first step is directly linked with the user analysis. The second one is related to the level of user or product control. Next, it is recommended the setup of the strategy definition; and finally the definition of the means to incorporate strategies to the product. Polizzi et al. (2016) explored how user behavior can be modelled inside the use phase of a LCA, developing a conceptual model based on the mutual interaction between behavioral science, life

cycle assessment, and ecodesign. Cor and Zwolinski (2014), presented a procedure for the determination of what kind of design intervention strategies can be implemented by designers for the improvement of the global environmental performance during the use phase of a product. Daedlow et al. (2016), believed that reflection and assessment of socially responsible research processes leverage sustainability transformation. They suggested a framework which integrates a series of criteria of societal responsibility from different disciplines. These criteria make the framework operational and enhance assessments of societal responsibility. Finally, Madani et al. (2017) provided an overview of game-based learning for environmental management, facilitating environmental education. An online database for “Serious Games” used for finding the appropriate information relating to the existing environmental games and their applications.

3. Methodology

According to the technology-push and the market-pull product design approaches (Horbach et al., 2012), the model of sustainability push & pull was generated by the need for sustainability consciousness from the majority of people and its rising importance. Market pull refers to the market need for new products and services. Society has an ever increasing demand for greener products and cultivation of sustainability behavior. Therefore, according to sustainability pull approach eco products which promote the meaning of sustainability to users, should be developed. The term technology push usually does not involve market

research. Products are pushed into the market without proper considerations of customer needs. Respectively, sustainability push specifies the need for a more sustainable way of life. Therefore, eco products with environmental friendly operation which create mindful interaction between the users and their green character should be developed. Sustainability push & pull can be considered as an alternative model for product design. The products developed under this umbrella aim to spread the meaning of sustainable development to citizens promoting a socially and a more sustainable behavior at the same time.

For a better understanding of the model, two new methodologies have been developed and used as representative examples. For the case of sustainability push approach, the Design for Green Usability (D.f.G.U) methodology was developed, while for the sustainability pull the Design for Promoting Sustainable Principles (D.f.P.S.P.) through user education methodology is proposed. Fig. 2 shows the whole design process which is built on three basic phases, the exploration of the idea, the generation of the product and finally the evaluation of how the product is developed according to the initial idea.

Designers should come near the people that they’re looking to serve, while searching for new creative solutions embedded in people’s actual needs. Product design should be focused to the user with the user in mind at all stages of the product development process. The research was based on a framework which was built according to the direct communication between citizens and designers. Encouraging people to change their behavior towards to a more sustainable behavior is not easy.

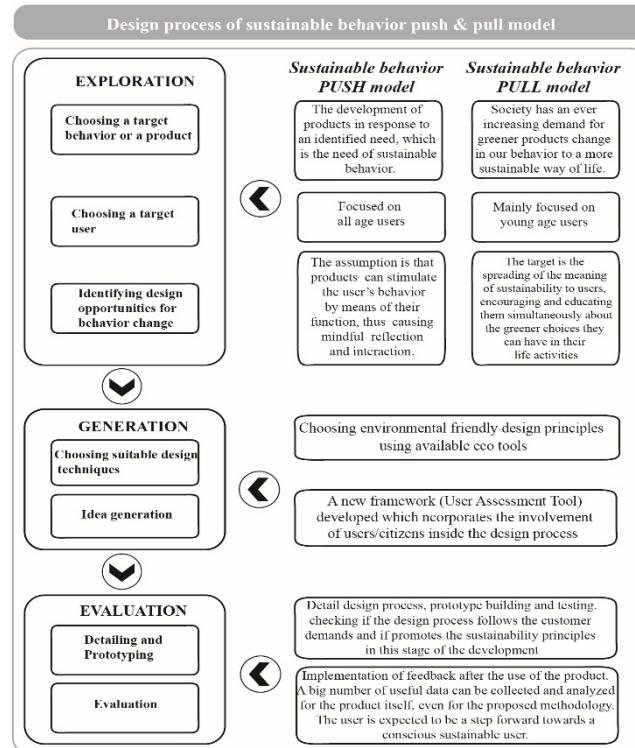


Fig. 2. Sustainability push & pull model. The basic phases of the whole process for the designed products

The research garnered responses from 72 participants (41 female and 31 male), who answered detailed questions during the whole design process. The majority of them were parents, whose kids participated to the use phase of the developed products under research.

Behavioural change developed methodologies try to explain why and how behaviours change. Nowadays, there is an increased attention in the application of this kind of theories in the area of product design and development. Understanding behavioural change is something very important as it can lead to the improvement of the offered services and the promotion of sustainable principles. According to Norman (2004), there are three basic levels of design: The visceral, behavioral, and reflective level of design. The visceral level of design is the first impression or reaction to an object. The attractive objects create good feelings to the users, making them to think positive and creatively. The behavioral level is based on the user interaction with the object functionality and physical attributes. The function, understandability, usability, and physical feel are the main elements. The function is one of the most important criteria. If a product does not satisfy its intended function, then it has failed. Furthermore, understandability, is one of the main reasons for the consumer satisfaction or disappointment. If the functions or the operations of a product are not understandable, then the product is not successful. Another important concept is the feel of the object, its use, the materials, form, and shape. The reflective level is something directly related on how the consumers communicates with the image of the object, and how it makes them feel. 'It is all about message, about culture, and about the meaning of a product or its use. Reflection is not a purely cognitive activity, but is folded into all our ways of seeing and experiencing the world. The three levels all combine

to form the entire product experience. Both methodologies are built based on the aforementioned levels of design, having the user in mind at all stages of the product development process.

The D.f.G.U methodology focuses on the creation of mindful interaction between the users and the green use of the products (Efkolidis et al., 2015a). Products are developed in order to be and operate really environmental friendly, simultaneously motivating the user to try them. A characteristic case of a product development under D.f.G.U methodology is the development of the "Eco-Bench". It is a bench (Fig. 3), which was designed under eco design guidelines, to operate collecting solar energy in order to be self-illuminated during the night time. Additionally, it provides electric power for user needs and information display for making easier and safer the city tour. The green character is the core of the product as all the useful functions are available due to the solar energy. The use of that kind of products makes the user automatically a conscious 'green' user.

4. Case studies

For the case of sustainability pull model, a new methodology named Design for Promoting Sustainable Principles (D.f.P.S.P) through user education was developed and used. The D.f.P.S.P through user education has as target the spreading of the meaning of sustainability to users, encouraging and educating them simultaneously, about the greener choices they can have in their everyday activities. The whole concept is mainly built for young age users and their parents. The basic reason for selecting the young users is that managing the improvement of sustainable behavior towards the young customers of today, it means automatically more sustainable conscious citizens and parents of tomorrow.

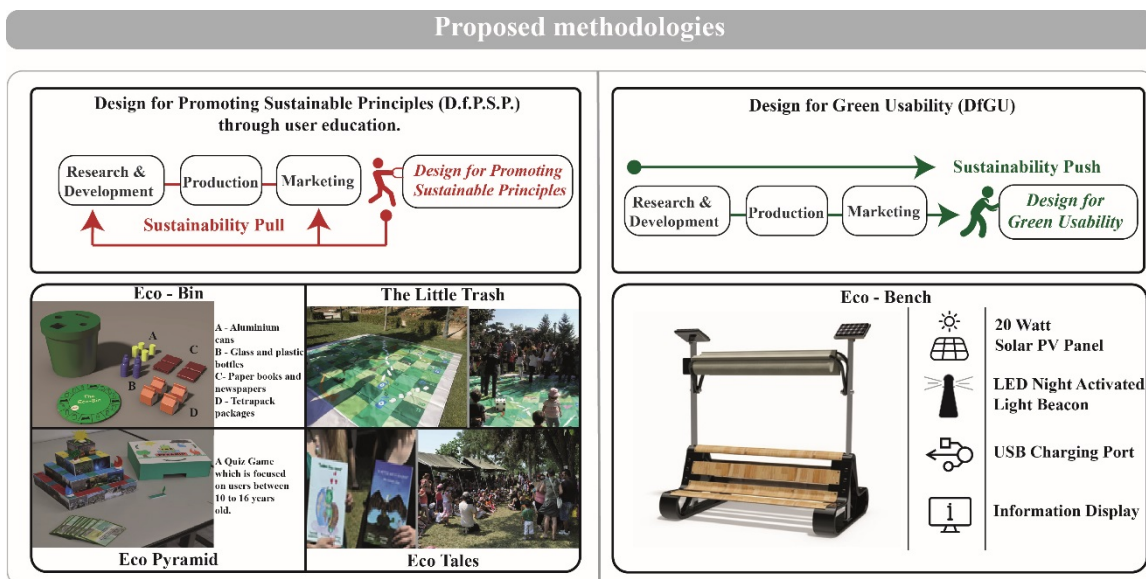


Fig. 3. Developed products under proposed methodologies

Game-based learning has been found to increase skills, such as critical thinking, creative problem solving and teamwork. Environmental management games can be applied in educational settings to promote awareness about sustainable resource planning and management among citizens who are increasingly exposed to products of the information age. As representative examples has been chosen a series of different products (Fig. 3) which were developed in order to prove the efficiency of the proposed D.f.P.S.P. through user education methodology (Efkolidis et al., 2015b). In the present paper, the selected products in order to be developed, keeping in mind all the principles previously mentioned, were toys, games and comics with environmental and social context.

Specifically, under the research has been developed the “eco-bin” toy, a toy for young users in the age range of 3-5 years old which transforms the action of recycling to a game. For the young users in the age range of 5-10 years old a new game named “little trash” was redesigned and developed. The game is composed from a 5x5m canvas and the pawns are the users themselves. All the environmentally friendly actions help the player to climb on the top and be the winner of the game, in contrast all the environmental pollution actions equals to lose the game.

Furthermore, a new quiz game named “Eco-pyramid” was developed for the users between 10 to 16 years old. The educational character of this game gives the opportunity for passing many sustainable messages to the users; making clear to them the current environmental situation, promoting simultaneously the importance of sustainable development. Finally, under the same philosophy of passing sustainable messages to young ages via entertainment, two comics were designed and developed. The real heroes are those who protect the environment giving the ability to the future generations to meet their own needs. There is a demand for behavior transformation to the young people in order to obtain the appropriate culture early enough in their life.

The whole process was accomplished according to the proposed framework (Fig. 4). User assessment tool helps designer to communicate with the consumers, designing for their values and needs, including them in the whole process of product development. It is a creative and educating process as the individual user opinion is the center of interest and plays an important role in the product design. The communication between designers and users was taking place by a questionnaire and several interview sessions. The 5-likert scale questionnaires were used for all the subjects that were directly linked with the sustainability issues. This kind of questionnaires was chosen because of the need for the comparability of the results (pre and post product development). For the aesthetic and functional issues such as shape, form, colour, texture, symmetry and proportion of the

developed products, the method of interview was selected as the most appropriate. With this way, the designers can directly illustrate their initial ideas and features to the users, test various aspects of a design and gather early user feedback. Derived research data from the questionnaire and interviews were analysed according to the proposed Miles and Huberman (1994) data analysis.

During the first phase of Summarizing interviews and questionnaire data, the data were deconstructed into broad codes. After that, in the data display phase, each one of them was verbatim transcribed and then was coded according to identified themes/categories. Then the required data was presented to the participants in order to ensure its accuracy. The further analysis of coded data was accomplished in order to be able to export conclusions. Themes were classified between the subjects were directly linked with the sustainability issues and aesthetic and functional issues. In the last step of the data analysis process, identification of patterns from the transcribed data were developed to verify the findings, provide significant description, propose explanations and draw conclusions.

Firstly, user considerations about needs, wishes, characteristics and abilities were taken into account as a starting point and were checked after the completion of the product development. During the feasibility and specification stage, the participants had to think about issues that are related with sustainable characteristics of the products under development. The straight contact at early stage of the design process with the final users, allowed the discovery of those elements which could stimulate their behavior to a more sustainable way of usage.

The next phase is the conceptual design phase. Eco-design principles that included to the concepts were showed and assessed by the participants. Two different questionnaires were used at that stage. The first questionnaire was focused to the product functionality, aesthetics and ergonomics. The second one was targeted to the evaluation of the product sustainable character by assessing the participant's desire for use.

The communication between designers and users was taking place by a questionnaire and several interview sessions, in order the customer perception about the product to be captured. For the next step, the research went further to activities such as detail design, prototype building and testing. It was then that a new customer assessment was implemented, in order to offer the opportunity for checking if the design process followed the customer demands and if promoted the sustainability principles in that stage was achieved. These activities guided to decisions about redesigning the product. In order to evaluate the success of the product, a final questionnaire was completed after the use of the product. A large number of useful data collected and analyzed for each product itself, even for the proposed methodology.

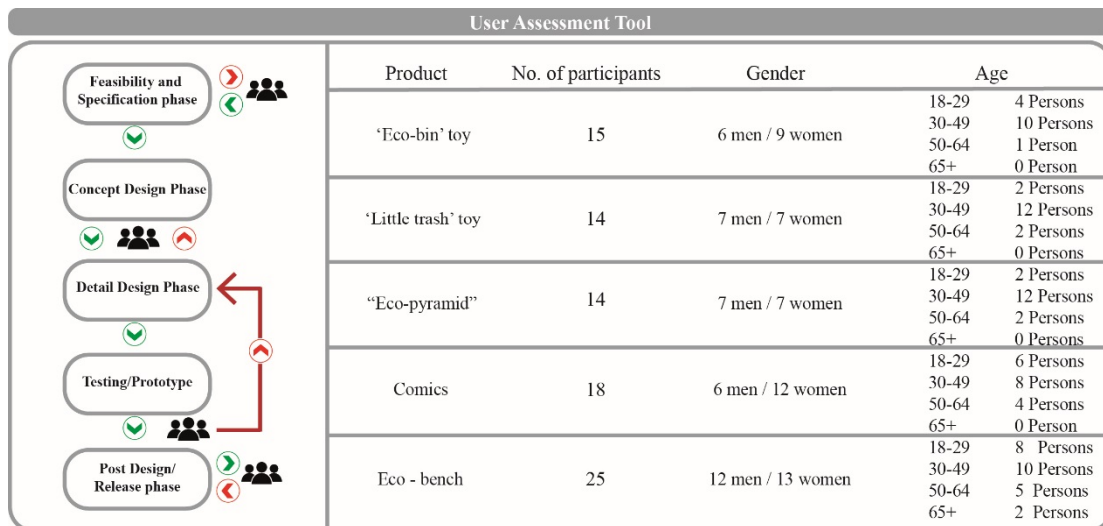


Fig. 4. The proposed framework/information about the research participants

User assessment tool helps designer to communicate with the consumers, designing for their values and needs, including them in the whole process of product development. It is a creative and educating process as the individual user opinion is the center of interest and plays an important role in the product design.

5. Results and evaluation

This framework was used during the design process of the research. For the products which were designed and developed under the Design for Promoting Sustainable Principles (D.f.P.S.P) methodology, the process was integrated as the products released to the final users and obtained their feedback. In the case of 'Eco-bench' which was designed under the Design for Green Usability (D.f.G.U) methodology, the process came just before the released phase and returned to the detail design phase. It is worthy to be noticed that the information display device is something which added to the product characteristics after the participant's feedback, which was obtained from the testing and prototype phase. A series of outcomes were concluded after the user experience in contributing to the design process of the product. This had as main target the user education about social and environmental responsible behavior. Table 1 outlines the mean values of the assessment results:

In the case of Products developed under D.f.P.S.P methodology (47 participants):

- Although half of the participants were not sure about what sustainable development exactly means, approximately 20% of them understood its meaning while involving to the whole process.
- Approximately 20% more participants mentioned that they are willing to purchase this kind of products, even if its price was greater than the similar traditionally designed toys.

- 82% of the participants were satisfied about their contribution to the design process of a product. After the completion of the whole process the result was increased to 94%.
- 16% more participants recognize the need for 'greener' designed products, acknowledging the need to become environmentally educated customers.
- When initially measuring their perception about the importance of the three sustainable development pillars, the results where 64%, 78% and 66% acceptance of environmental, social and economic issues. After the completion of the whole process the result was increased to 78%, 86%, 76% respectively.
- Initially, 74% of the participants supported efforts focused on a cultural transformation to a more sustainable behavior. The whole process strengthened this attitude to 84%.
- Initially, 62% of the participants were expected that research methodology could promote social and environmental behavioral change. After the completion of the research 88% of them were convinced that successfully accomplishment of the research methodology can promote successfully a social and environmental behavioral change.

For the case of product (eco-bench) under D.f.G.U methodology: (25 participants)

- Initially, 78% of the participants were satisfied about their contribution to the design process of a product, 64% recognizes the need for 'greener' designed products and 74% supported efforts focused on a cultural transformation to a more sustainable behavior.
- 62% of the participants believe that green usability of a product plays a key role to sustainable behavior.
- 48% of the participants believe that the green character of the product makes it more attractive to the user.

The results from both the questionnaires and interviews (pre and post product development) for the first case and pre product development for the second

case are very encouraging for the further development of the research. For the products developed under the D.f.P.S.P methodology the difference on the answers (Fig. 5), depicts the positive view to the whole process and makes clear that the research methodology is interesting and friendly for both the users/citizens and designers.

Moreover, the results show that the whole process is very educating. At the final customer assessment (after the use) the proportions of knowledge about sustainability were increasing drastically. For the product developed under the Design for Green Usability case, the initial data can be considered as encouraging for the continuation of the product development.

6. Discussion

As mentioned before Design for X refers to the use of a methodology to optimize a specific aspect of a design. The variable X represents the areas of focus. This research focuses on user socio-cultural transformation towards to more sustainable consumption behaviour via products, which promote the sustainable principles through user education and the green usability. In order these aims to be achieved, the whole design process of the products and their character are user oriented as they have the user in the center of interest. The research proposes two “design for” methodologies which are directly related to the

use and the end of life phases. Essentially, by understanding the user, it becomes possible to use design to educate him about sustainability issues and effectively push him towards more sustainable product use. The development and promotion of a “green” lifestyle is social fair in order to obtain more sustainable communities. For the development of a process or a product, perhaps one of the most challenging aspects of the Social Centered Design is the complete understanding of the user’s point of view.

For this reason, during the design process, it is mandatory to involve the social groups and communities, when developing ideas for addressing urgent social needs and problems. Understanding and modelling human behaviour is something difficult to be managed. The only way is via the interaction with the users/citizens capturing their beliefs and experiences.

It is important to grasp the need for a change in our behavior and to start thinking the promotion of a more socially equal and environmentally friendly way of life. The gained experiences from the direct communication with the participants/citizens and their positive feedback for the whole process guides the current research to the implementation of the proposed framework to existing or new ‘Design for X’ methodologies, but more socially oriented. As a representative one can be considered the Design for Homeless.

Table 1. Results of the participant’s satisfaction assessment

<i>Products developed under D.f.P.S.P methodology</i>		
<i>Item (Five-level Likert: 0 = “Totally disagree” ; 5 = “Totally agree”)</i>	<i>Initial questionnaire/interview Average Value</i>	<i>Final questionnaire/interview Average Value</i>
1. I know what exactly sustainable development means.	2.9	3.8
2. I prefer to buy environmentally designed toys for my kids, even if that means that I must pay more for its acquisition.	3.0	4.1
3. I enjoy the fact that I can participate in the design process of a product and contribute to its future	4.1	4.7
4. I recognize the need for sustainable designed products, acknowledging the need to become environmentally educated to customers.	3.1	3.8
5. Put in the row the importance of the three sustainable development pillars (Social-Environmental-Economic).	S. 3.2 Env. 3.9 Ec. 3.3	S. 3.9 Env. 4.3 Ec. 3.8
6. I understand the aim for the user cultural transformation to a more sustainable behavior.	3.7	4.2
7. I expect/convinced that products designed under research methodology can promote successfully a social and environmental behavioral change.	Expected 3.1	Convinced 4.4
<i>Product developed under D.f.G.U methodology</i>		
1. I believe that green usability of a product plays a key role to sustainable behavior.	3.1	--
2. I enjoy the fact that I can participate in the design process of a product and contribute to its future	3.9	--
3. I recognize the need for sustainable designed products, acknowledging the need to become environmentally educated to customers.	3.2	--
4. I believe that the green character of the product makes it more attractive to the user.	2.4	--
5. I understand the aim for the user cultural transformation to a more sustainable behavior.	3.8	--

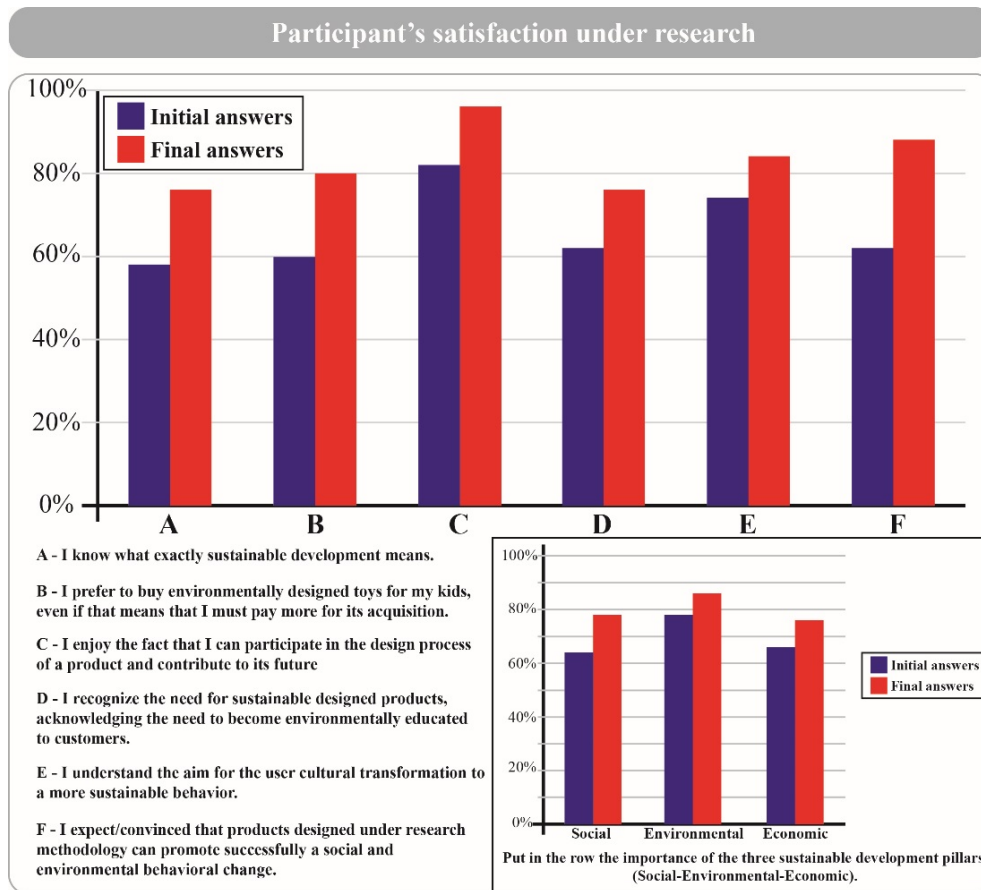


Fig. 5. Participant's satisfaction for products developed under D.f.P.S.P methodology

Homelessness is the condition of people without a dwelling house. Latest research show that single homeless adults are more likely to be male than female while the number of homeless families with children has increased significantly over the past decade. Homelessness is an undeniable social problem. The Design for Homelessness should be targeted to develop techniques oriented to the successfully confrontation and eradication of the homelessness. Dickinson et al. (2017) tested some student prototyped portable shelter with men who were homeless. The data collection from the direct communication between the students and the homeless persons via interview questions emerged a number of themes such as dignity, safety, security, control, privacy, and portability. Giving to these men the opportunity to express their needs and their feelings, allowing them to test the prototype product, gave to the research team a better view of design characteristics needed for portable homeless shelters. Designers should be ready to face this problem giving solutions to the physical facilities aspect of this issue. One of the most challenging aspect is the fully understanding a Homeless person's point of view. This experience can effect a dramatic change in a person's world view, impacting their needs and priorities.

Another challenge can be considered the Design for Refugees. The refugee crisis is one of the most important and unsolvable problems in the

modern world. The refugee crisis is a human crisis and requires time and a series of far-reaching global efforts to solve. Design for refugees should have as target the Improvement of their life making easier their needs satisfaction, but also their normal adaptation from the communities which are directly involved. Dyer et al. (2017) created a new design module for undergraduate engineering students to design and build temporary shelters for a wide variety of end users from refugees, to the homeless and children. The result was that even though the module provided guidance on principles of design thinking and methods for observing users needs through field studies, the students found it difficult to respond to needs of specific end users but instead focused more on purely technical issues. Almohamed et al. (2017) investigated the factors that affect the social capital of newly arrived refugees in Australia and the role of information and communication technology in supporting the rebuilding of their social capital. They presented the findings from 3 participatory design workshops involving 14 newly arrived refugees from persecuted minorities in Iraq and Syria.

The result of the research was that three main factors affected social capital for newcomer refugees: cultural adjustment, organizational support, and social activities and support. Of course, designers and engineers can't save the world themselves, but even the smallest intervention could help improve the conditions to the cities and society.

7. Conclusions

The development of such studies is an important aspect for sustainable development. Rather than design focusing solely on economic and environmental aspects, designers should focus on society's most important challenges and problems: access to clean water, better sanitation, poverty or malnutrition, female empowerment, crime and so on. Design should be driven not solely by commercial needs, but by social impact. There is time to pass from "human-centred design" to "humanity-centred design", creating a better world for the present and future generations of this planet.

Designing products with techniques and technologies environmentally friendly cannot be by itself the solution towards a better resource's management. As reported before two 'design for' methodologies, Design for Promoting Sustainable Principles through user education and Design for Green Usability developed and experimentally used following the guidelines of the User Assessment Tool. Both methodologies focus to the shortage of social and user oriented methodologies, filling the gap, in order to be achieved a socio-cultural transformation towards to a more sustainable production and consumption behaviour. User Assessment Tool is a tool based on "user-centred" approaches which has as main target to promote sustainable design and production to the designers and engineers and to cultivate sustainable consumption lifestyle to the users/citizens. Despite the small scale approach, the results can be considered only as positive.

According to the users/citizens opinion about the whole process, this study should be continued while managed to improve factors such participation, interest, friendliness and even behavioral change. The obtained experience including the improvement of our communication skills with the users will be useful for the future plans which are focused on product development which aims to influence user/citizen behaviour, through design, for social and environmental benefits. Product design can enhance the present and future lifestyles motivating citizens to change their lifestyle towards a more sustainable attitude.

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