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IMPLEMENTING ECODESIGN PRINCIPLES IN PRODUCT DESIGN: THE ROLE OF USABILITY

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Abstract

The market growing saturation with products similar to the already existent ones or whose adaptation to a user revealed inefficiency, makes relevant the elaboration of projects that effectively bring competitive advantage and consequently contribute to the development and well-being of the society and the ecosystem.

With this paper it is intended to elaborate a project methodology which encompasses the concepts inherent to sustainability in conjunction with user-centered design.

The study of these areas - the combination of ecodesign and usability criteria - culminates in a methodology which was applied to the redesign of a vacuum cleaner, as illustrative form, divided into two relevant phases, which are: (i) recognition of the users real needs, as well as problems associated with the product, through research and usability testing (N=120), and (ii) the product environmental impact quantification, through the eco-indicator 99 method.

Thus, the criteria to be incorporated into the product are defined with the aim of applying characteristics that point to improve the usability of the product, but also keeping them compatible with ecological solutions and therefore sustainable.

Keywords: Project Methodology, Sustainability, User-centered Design, Ecodesign, Ergonomics.

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1 INTRODUCTION

When nature stopped being able to meet the needs of the human being, due to a massive use of its finite resources, several actions that were inevitable were notorious, but surely detrimental to the environment. In this context, several measures have been adopted, aiming for the reduction of the negative effect of these actions. However, every day new products are created, with a new impact, which translates in an increasingly smaller conception time, overcrowding markets and creating unnecessary waste. Sustainable development, broadily defined as "the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland Report, 1987, p. 24), is today a central concern of most developed countries and has been under investigation by several research groups and international organizations. In this context, the designer should take a proactive position, warning society about the impact that his work can promote in the ecosystem, minimizing it and educating society.

However, it should be noted that many products overload the markets because they have not been well accepted by their end-users, either because they cause constraints, accidents, frustration or simply because they don’t provide any competitive advantage on their predecessors. Crawford (1987) evaluates the failure rate at 39% for consumer products and 31% for industrial products.

These conclusions show that through these user requirements, converging technological innovation through eco-design guidelines while aiming for society’s interest is extremely pertinent. Thus, innovation must converge to a greater interaction with various requirements relating to the performance of the product in its use phase.

Among the various disciplines which support the process of design, ergonomics seeks to respond directly to the user’s needs, connecting this discipline with ecodesign, which means developing ecologically efficient products, as well as usability-efficient. Integrating accessibility, anthropometry, ergonomics and usability with design allows the development of solutions more suited to the real needs of users (Paschoarelli & Menezes, 2009). Thus, the designer should enhance the functional capacity of the product’s user, as well as his expectations, identifying usage problems and adapting the products to human needs, using specific public-adjustable methodologies (Baptista & Martins, 2004).

The vast majority of the agents which are responsible for the product design often need support, in order to realize how to apply sustainable development methodologies in a specific product that has an added value. The great challenge that companies face today is how to create strategies and new models that generate prosperity (Hamel & Pahalad, 1994). The adoption of a clear strategy enables new business opportunities, economic and process security, and sustainability.

As such, the methodologies are fundamental, in this context, providing guidelines for the development of products, based on studies of targeted and validated principles and procedures.

2 SUSTAINABILITY AND USABILITY IN PRODUCT DEVELOPMENT

Nowadays, there is an overload of products on the market with little added value, Turra (2002). Product development happens at a great speed, everyday are introduced to the market new products with the objective of responding to the competition that often generates products with little advantage in relation to the already existent on the market (Gerst, Eckert, Clarkson & Lindemann, 2001). Due to the fact that companies work on a race against the clock, in which each one seeks to be a pioneer in some aspect, there are phases of the project which are "forgotten" precisely because they are more time-consuming and cause a delay on the release date of the product to the market. Studies regarding the end-user are an example of this, Moraes (2004). The products are increasingly produced with the prospect of trial and error (Eckert, Clarkson & Zanker, 2004), which will cause a financial loss, one way or another. Products are tested when being released on the market, Moraes (2004), so the user’s feedback only exists on that stage. Consequently, identified flaws that should be resolved in future projects. In order to try counteracting this trend, it is necessary to formulate more efficient strategies, which justify the end-user interaction throughout the development of the project, not at the end, Eason (1995). These strategies consist on the interconnection of areas directly related to these problems, in the process of product development. Therefore it becomes pertinent to elaborate a work methodology that can adapt the user’s needs to the needs of the ecosystem. To this end, the usage phase, where the interaction user-product occurs, reveals the crucial points which are needed in order to identify the product acceptance criteria, where: (i) usability checks what the user needs; (ii) ergonomics translates the way these needs should be met; and (iii) the ecodesign appears as a mandatory condition, which aims to minimize the damage to the ecosystem, as well as being as an emotional advantage caused by the environmental awareness that has been increasing on the society.

3 JUSTIFICATION OF THE METHODOLOGY

Several authors (Lobach, 2001; Forty, 2007; Lofthouse, 1999; Papanek, 1995; Vezzoli, 2008; Charter, 2001; Brezet & Van Hemel, 1997; Manzini, 2009), comment on the way design must configure a project methodology which leads to the development of sustainable products. Hill (1993) sets out eight key aspects of ecodesign - use of clean technologies, reduction of the emission of chemicals, reduction of energy consumption, use of non-toxic materials, use of recycled materials, reuse of components, design for an easy disassembly, reuse or recycling of the product at its life's ending. Luke (2002) is more explicit and incorporates concern for users in the set of principles (e.g., maximizing user satisfaction; educate consumers) that should be used in this context. Tompson (1999); Keoleian and Menerey (1993); Brezet and Van Hemel (1997) present a set of strategies to facilitate the understanding and importance of applying such principles (e.g., administration of materials; extend the shelf life of the product; reducing the material intensity; life extension materials; design for disassembly; recycling of materials).

Thus, a redesign project emphasizes aspects related to the analysis of the product's life cycle. However, this analysis should be done with the help of the eco-indicator 99, due to the fact that it is a simple method of evaluation of the ecological load, likely to be used by professionals with few knowledge on ecology, such as designers.

On the other hand, there is a dependency relationship between the user and the product (Bernd Lobach, 2001; Urban & Hauser, 1993). This relationship can be studied from the ergonomics point of view, authors such as Pheasant (1988), Karwowski, Smith and Stanton (2011), Dul and Weerdmeester (2004) state that this area is crucial for a project-oriented development, optimized for the user's well-being and consequently for the performance of the product. In this context, in a product's development process, usability and ergonomics are interconnected (Moraes & Mont'Alvão, 2003).

Concerning usability, Abras, Maloney-krichmar and Preece (2004), and Preece, Rogers and Sharp (2002), formulate a series of complementary principles (e.g., effectiveness, efficiency, safety, usefulness, capacity of learning and memorization; ease of learning, ease of use, efficiency of use and productivity, user satisfaction, flexibility, usefulness, security in use) and that go against the ideologies of ISO standards (e.g., effectiveness, efficiency and satisfaction) and other authors (Nielsen, 1993; Moraes, 2004; Stanton & Barber, 1996; Rubin, 1994). Preece, Rogers and Sharp (2002), suggest some usability techniques for the development of a product, highliting the interviews, questionnaires, observation and the usability tests, defended also by Montmollin (1990), Jordan (1998) and by Dumas and Redish (1993). In his turn Nielsen (1993), introduces the development process of usability testing in seven fundamental steps: (i) definition of the test; (ii) selecting participants; (iii) definition of the tests' scenario; (iv) definition of procedures and metrics; (v) pilot test; (vi) report; (vii) analysis.

Therefore, the adopted methodology was a junction of several ideas defended by these authors. Generally speaking, as the intention is to redesign a product: firstly by studying the existing product regarding its usage, then the approach suggested by Preece, Rogers and Sharp (2002), and prescribed by Nielsen (1993), and defended also by Rubin (1994), where the goals of consensual usability, to Nielsen (1993) have been adapted; Dix, Finlay, Abowd e Beale (2004); Preece, Rogers e Sharp (2002); - (i.e., ease of use, maintenance, quality of materials, Effectiveness, performance, comfort, safety, endurance, Environmental Impact). In a second phase the aim is to assess the impact of the product, and the eco-indicator 99 method was used, in order to adopt the ecodesign strategies suggested by Thompson (1999), such as optimising the management of materials, extending the product's life, fostering the design for disassembly and recycling of materials; by Keoleian and Monerey (1993), (product's life span, life extension materials and selection of materials); and by Brezet and Van Hemel (1997), with the ecodesign strategy wheel. This trajectory culminates in project-oriented methodology, minutely described in the following section.

4 METHODOLOGY

The methodological procedure is divided into two phases: (i) the analysis phase – focused on the user and (ii) the project – that investigates the environmental impact of the product under study.

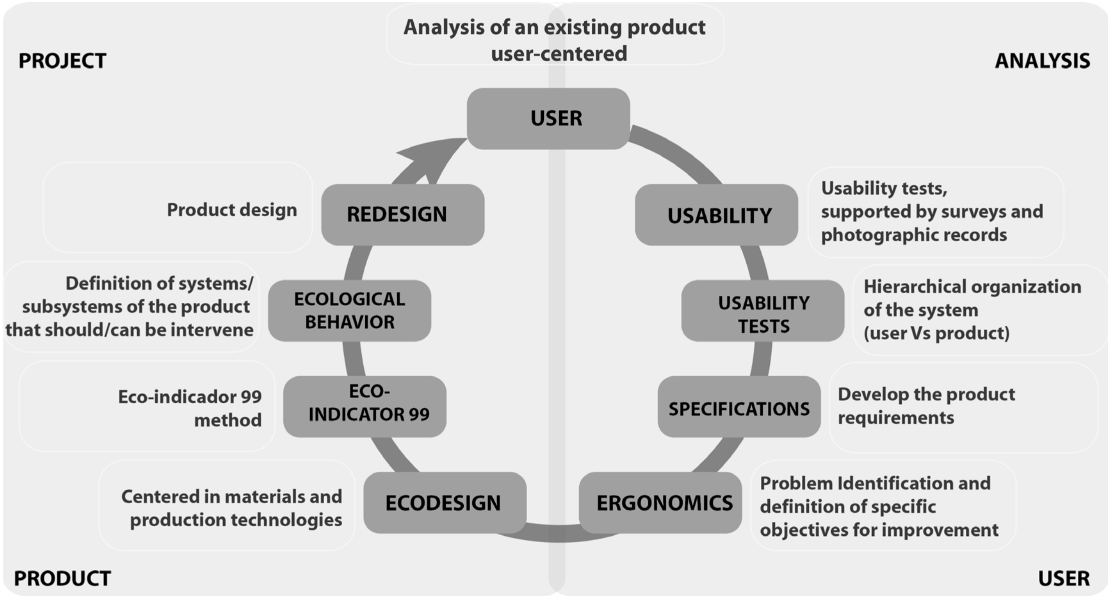

Figure 1: Diagram of the adopted methodology.

Figure 1 illustrates the methodological process adopted. As it is possible to see, this methodology is a circular system. In the first task, after selecting the product, it is necessary to analyze the product by means of the real needs and expectations of the user (Moraes, 2001). Here, usability emerges as a discipline that connects these two issues – the analysis of an existing product and a user-centered process. To this end, the method of usability tests is adjusted to the subject, which provide the required data through responses and activities of a given sample of individuals. Preece, Rogers and Sharp (2002), referred to the purpose of these tests as the technique used for the "collection of data relating to quantities measurable usability criteria ". Dumas and Redish (1993), support these authors, stating that that the goals of usability testing are "improving the usability of the product, involve real users in the test, give users real tasks to perform, allow the evaluators to observe and record the actions of participants and allow appraisers to analyze data obtained, thus changing factors accordingly".

The implementation and analysis of the usability tests supported with surveys and photographic records, seeks to identify the evident problems both from similar products as well as from the actual product studied. This analysis allows tracing the specific targets of intervention for the redesign of the product, in terms of ergonomics, safety, ecology, among others issues that are relevant.

This definition of the specific objectives is, fundamentally, about the actions which need to be done in order to improve the flaws that were found.These tests are carried out to a sample of individuals, which allows organizing the data by the accumulated sum of errors in a hierarchical system that represents the problems with more incidents. With this hierarchical organization system (problems in the Human-Product interaction) it is possible to organize the requirements and parameters of the redesign project. These requirements and parameters are then studied, based on the concepts of ergonomics (which aim to give a first answer and solution to these faults identified), tracing the intervention objectives for project requirements which were already identified by the outcome of usability tests.

After evaluating users' behavior it is necessary to assess the ecological impact of the product. In this task ecodesign is implemented, since it is oriented towards the minimization of resources that allows, through the eco-indicator 99 method to evaluate the 'ecological load' of the product. In this case, this assessment is centered on the materials and their manufacturing processes, leaving aside all electrical components.The eco-indicator 99 method details the system or subsystems of a product according to their environmental impact, in this way it is possible to identify the parts where is possible to intervene in order to develop the redesign into a more environmentally friendly product. After evaluating the user in a first task, and the product in a second, there is reliable data to organize the requirements and parameters of the project. If in one hand there were recognized the needs and expectations of the user (what to do), on the other there were verified where to intervene (where to act), in an attempt to generate a product that meets the needs of its user while respecting environmental resources, as has already been mentioned.

The next task of generating concepts, is where solutions are materialized through the requirements formulated - Redesign. In this task, alternatives should be detailed and finally analyzed with the aim of trying to understand the one that is the suitable solution to the intended concept. The chosen concept should be prototyped for validation, with new usability testing with the user. The justification for this intervention is performed by redesigning an object using the suggested approach, exemplified in the following section.

5 PROJECT – IMPLEMENTATION OF METHODOLOGY

5.1 Product

To verify the product usability, it is used a vacuum cleaner as a case study, because it is an essential product that is used in most households on a daily basis. This is an appliance that has not been undergoing significant improvements about its impact on the environment, but on the other hand, corresponds to an invention of the last century that allowed to perform household chores with less effort, improving living conditions and comfort of those who perform them.
The model was chosen according to data from *DECO Proteste*, which characterizes it as the best choice. *DECO – Associação Portuguesa para a Defesa do Consumidor* (Portuguese Association for Consumer Protection) is an organization whose mission is to defend the legitimate rights and interests of consumers.

5.2 Usability tests

Usability tests attempt to measure users' performance (number of errors, and duration of the task) during the experience of using the system, with a quantitative approach (Souza et al., 1999). Other authors, such as Preece et al. (2005), Pressman and Lowe (2009), Silva and Barbosa (2010) and Nielsen and Loranger (2007) argue that the results of the usability tests also have a qualitative approach, it is necessary to judge and interpret the results with the purpose of identify problems and the recommend solutions. In this way, with the completion of these tests, it is intended to coalesce these quantitative and qualitative approach. That is, if on one hand the qualitative approach provides data that allow us to identify direct or indirect problems concerning the usability of the product, on the other hand the quantitative approach will dictate the number of occurrences of these errors or problems, thus prioritizing those who deserve more attention.

5.2.1 Method

The sample testing (N = 120) is characterized by adults, divided into 6 groups by age and gender. At this stage surveys with 26 closed questions were performed to acquire data on the experience and feedback of users interacting with similar products. Usability tests are performed, involving 7 general tasks, subdivided into a total of 23 activities. These activities were based on the cleaner’s instruction book. Initially the usability tests were recorded on sheets of paper, being the surveys manually completed after printed, as well as the tests of the tasks themselves. These were also completed with photographic records. Subsequently, the data was transferred to a statistical analysis software, the Statical Package for the Social Sciences (SPSS), which transforms the data into information, organizing and summarizing data sets, making the results of usability testing more understandable.

5.2.2 Results

Through a comparative analysis between the responses of the various respondents, the data described below are highlighted amongst the collected data.
Vacuum cleaners are mostly used once a week (26,67%) or twice a week (25%), whether it is at home (50,79%), whether it is in the car (41,36%). This last one is more common in male users, with ages ranging between 20 and 30 years old. The age and gender especially delimit the context of use, experience and concerns about product performance. There is a greater use among the female population, but men are who have an approach more conscious about the characteristics and performance of this type of products. This awareness is most noticeable depending of the individuals’ maturity. This analysis also finds that there are functions in the product that in some way become unnecessary, eg, it was found that there are many accessories, many of them rarely used, 63,33% of the respondents stated they did not use any accessories; only one of the two suction power regulators

is used, so the one located in the handle is normally overlooked by 87.18% of subjects. Regarding the product disposal, it is noticed that a significant majority of users do not disassemble the vacuum to store it, only 22.5% of the individuals said to disassemble it, this is due to the fact that it is kept in a storeroom (53.54%) or in the garage (19.69%). The characteristics that deserve more attention, in the act of purchasing a new product are, in order of importance, power (19.34%), price (16.87%), ease of use (10.49%) and weight (7.82%), however it became visible a confusion between power and suction power, because users associate that the greater the power of the device (78.99%) the product has more suction power, which does not match to reality. On other hand, they have reported to have ecological concerns, namely, energy consumption (63.39%), taking into account the previous data we can conclude that there is a contradiction because they seek products with higher power therefore with higher energy expenditure. As for the frustrations experienced during the use of this kind of products, stands out, for degree of incidence, noise (15.22%), the wire size (14.73%), the clash with furniture (13.29%), accessibility to difficult areas (12.56%), insufficient sucking power (12.32%) and weight (7%). After the survey, tests provided validation to some of the given answers. An important finding was that the majority of the respondents said that they changed the vacuum filters (72,27%), mostly after a few uses (45,45%) or when they noticed a product performance decrease (30,68%), however during the tests they only identified the air filter, and that was unknown to these users (89%) the existence of the engine filter. Users, in general, also stated that most of the malfunctions in their vacuum cleaners were due to overheating (25.60%) or unknown failure (30.40%), so it can be conclude that this failure could have been the result of poor product maintenance, namely poor filter maintenance (i.e., when one of them was forgotten).
Regarding the tasks success and failure, most of them were intuitive. The errors found indicate that, there is a need to check, the motor filter, adjust the suction power, change the nozzle according to the surface to be treated, adjust the size of the wire and last but the most common one, to use the slots of storage, which rarely happened (only 6 subjects performed this task).

5.2.3 Conclusions Vs Requirements

From the data collected, the requirements and parameters of the project were defined, focused on usability. The analyzed project presented the following requirements: (i) Highlight the need to change or clean both filters: this requirement comes from the need to improve the maintenance of the product, since it was verified that, especially the motor filter, would be forgotten, which would lead to an overheating of the product and, consequently, its early failure; (ii) Simple fittings (which need a low pressure for the parts to fit in): some of the comments have criticised tye device’s fittings and, by observation, it was possible to verify that some pressure would be required, in order for one to be able to perform certain tasks, such as inserting the hose on the device; (iii) Decrease of tools: users have admitted not to use most of the utensils of the device; (iv) Intuitive Process: because most of the respondents claim not to read the product’s instruction manual, it is necessary to simplify the process so that all the stages of interaction are explained simply, from use to maintenance; (v) Possibility of interaction with the foot: some users had the habit to turn on/off or wrap the wire with the foot, however, in this vacuum cleaner, the buttons were snot big enough in order to happen this kind of interaction; (vi) Maintain or improve mobility; (vii) Maintain product stability: stability and mobility of the product were subjects of praise and should be requirements to maintain, since they satisfy the user; (viii) Maintain or reduce noise: noise is an element of differentiation between this product and similar ones, so it has already been optimised. However, according to investigations relating to vacuum cleaners in general, this parameter was referred to as troublesome, so it should be optimized even further, if possible. (ix) Reduce the device’s weight: the weight is mentioned in surveys as a usual frustration factor, as well as in the comments of usability tests, as a critic to the product. Therefore, it must be reduced, in order to meet the needs and preferences of users; (x) Improving the tube in terms of sensitivity (touch): the tube is referred to as 'heavy' and 'cold', revealing the sensory discomfort felt by the user; (xi) Try to improve the hot air output: during the tests, the respondents stated that they were bothered with the output of hot air by the air filter's output. It should be noted that the tests were carried out in the cold season, which leads us to believe that during the summer these complaints would reach higher dimensions; (xii) Implement marking on the wire’s limit: users are used to this small detail, because when trying to unwinding the cord, respondents revealed surprised when they could not to find it; (xiii) Extract or highlight the storage fittings: storage fittings were used by a very small number of participants, who admitted not to use them or being unaware of

their existence (not directly visible); (xiv) Highlight the handle's suction regulator: which, although very useful, is not readily apparent; (xv) More 'comfortable' materials: many of the respondents' comments referred to sensitivity issues (touch); (xvi) Minimize damage when crashing against furniture: frustration related to this ocurrance is mentioned in investigations.
These results provide data about the functional performance of the studied product. In order to make improvements in terms of ecology it is necessary to perform a study to reveal their ecological load, also in order to minimize it during the project's process.

5.3 Life Cycle Analysis (LCA)

Evaluating the life cycle allows the evaluation of the products environmental impact, with the environmental safeguard related to the optimized material and energy source choices, approaching it so the society, economy and environment have equal priority. This analysis seeks to verify the ecological burden of a domestic vacuum cleaner, by analyzing its LCA. In this case, the task is to identify flaws and improve the product, such as materials replacement, and subsequently the appliance of different technologies in the production process, and the reduction of residue when the products life ends. So, the limit of this analysis is the whole sets material, the products main body.

5.3.1 Method

In order to obtain the products ecological footprint, the eco-indicator 99 was used, because it is a method that allows the calculation to be done objectively and accurately with the limited data available (i.e., mass, material, processes). The values obtained by the calculation allow us to guide the interventions choices, in order to redesign the studied product. As previously stated, in this case the objective is to change the products body, which is mainly polymeric-based, where the material-related data that do not regard the vacuum cleaners electric component were excluded. So, the calculations result do not represent the vacuum cleaners ecological burden, but the target components, in this case, the materials that make up its body.
In the first stage, it was necessary to disassemble the vacuum cleaner, which allowed all the components to be analysed. This analysis' data was cataloged in a table, which contents included: (i) number of each piece; (ii) components photo; (iii) mass, in kilograms; (iv) type of material; and (v) manufacturing process.
These data were transferred to a previously prepared table, in order for the eco-indicator method to be applied (Eco-indicator 99, 2000).

5.3.2 Results

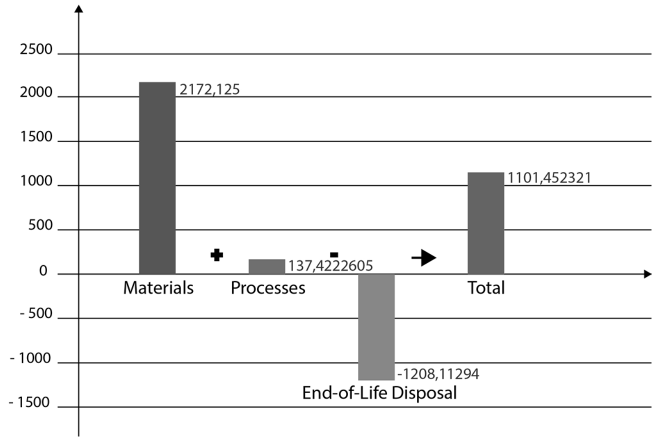

Figure 2. Eco-indicator 99

By looking at the above-presented graph, the final calculation result obtained by the eco-indicator 99, for the studied processes, is approximately 1101,45 milipoints, which represents a superior ecologic burden, compared to the one of an average European, in a year. However, in order to be able to compare the burden in these terms, the products burden had to be divided by the number of the total years of the products life, and that information cannot be obtained. These results will be afterwards compared to the product inherent to its design, and the objective is for this last product to have an inferior result, by replacing materials to more environmentally-compatible ones.

5.4 Conclusions

Through the data collected from the two analyses described above it is possible to predict and define the requirements and parameters that are essential to the product redesign. For example, if it is stated that there is an exaggeration of utensils, it is also possible to state that it becomes relevant to reduce them to those that are used most frequently. This reduction enables a reduction of utensil material, which enables the inclusion of ecodesign principles. This connection between the project's requirements and parameters was made according to data taken from the usability and ecological product load's calculations tests. In order for there to be a greater visibility of how it is possible to solve problems of one of the areas that shares other one's solutions, a possible redesign model was ran, which is summarized in the following section.

6 REDESIGN

In the phase that corresponds to the specification of functional requirements or usability delineated by early usability tests, user preferences were dictated by the data collected from the interaction between user and product, particularly in terms of ergonomics, safety and use. For example, regarding ergonomics, the need to minimize the occurrence of innadequate postures was notorious, including the improvement of buttons (enabling their interaction with the foot) and components' fittings (reducing the pressure required in order to mount/unmount the product); regarding safety, as well as caring for the shape and dimensions of the components, it was realized that it is essential to promote good and correct use of the product in order to reduce the malfunctions due to overheating (mainly); regarding usage, an attempt was made to promote a proper use of the product, in particular by simplifying this process. Finally, sustainability requirements are noted, indicating the use of more environmentally compatible materials.
While trying to find a material that can answer the requirements of ergonomics and usability, cork arises as the sustainable material which seems to the project the best.

6.1 Why Cork?

According to the Portuguese Cork Association (APCOR), cork has unique properties that no other product, whether natural or artificial, has managed, until now, to match or exceed: lightweight, impervious to liquids and gases, elastic and compressible, excellent thermal and acoustic insulator, burns slowly, very resistance to friction. The main component of cork is suberin, a mixture of organic acids from which the walls of their cells are made of, preventing the passage of water and gas. Suberin's properties are remarkable, because it's practically nonconsumable, insoluble in water, alcohol, ether, chloroform, concentrated sulphuric acid, hydrochloric acid, etc. The essence of Cork is defined by its cells, grouped into an alveolar structure feature. But it is, above all, a material that is 100 percent natural, recyclable and renewable, three attributes which are essential in a society such as ours, nowadays, wishing to be environmentally friendly, by polluting less and less.

6.1.1 Cork in the Project.

For each usability metric studied, some obvious problems were found, which then were tried to be solved with this redesign project. This process can be understood with the following table.
It is clear that the replacement of the product body's material by cork allows solving some of the problems. The next model, illustrated in the table, is a possible redesign of the vacuum cleaner, idealised based on data obtained during the two steps outlined in prototyping phase.

Table 1. Process

Usability metric	Problem / Note	Solution
Ease of Use	Difficulty in fittings	Fitting's simplification
	Filters	Visibility of filters
	Exaggerated length of the wire	Wire limit mark Implementation
	Weight	------
	Silent	Acoustic insulation material - Cork
	Cold tube	Pipe cork cover - thermal insulation.
	Hot air outlet	Reorientation of the air outlet

	Interaction with the foot	Button size increase
	Mobility	System 'always standing'
	Storage fittings	Red handle (arrow)
	Engine filter	Red handle (arrow)
	Regulator handle	Highlight the handle (red)
Simple maintenance	Filters maintenance	Filters visibility
	Bag maintenance	Bag visibility
Materials Quality	Filters quality	Keep
Effectiveness	Use of the carrying handle	Abolished
	Storage fittings	Highlighted
	Number of components	Reduced
Comfort	Noise	Acoustic insulation material - cork keep
	Wire Size	Keep
	Crashing on furniture	Ductile material - Cork
	Accessibility to difficult areas	Mobility - system 'always standing'
Security	-------------------------------------	Slowly combusting material, without surfaces with protruding corners.
Environmental Impact	-------------------------------------	Renewable, recyclable and reusable material. - Cork.

7 CONCLUSION

The problems inherent to the saturation of the market which contains products with little added value, and hence the excess waste that results from this saturation, led to the conclusion that the product development process is often not performed efficiently. The elaboration of a project-oriented methodology is a process that needs time, research and data, generated from standardized information that provide a theoretical basis about the workflow on a project so that specific methods that can be applied to different situations can be created. However, there is a number of problems that make it impossible for design professionals to develop their own methodology (e.g., response speed, lack of time to organize the process). This work then provides a research base, extending and adapting a base of studies which was already conducted by the authors cited in the course of the work, in order to make possible, in a similar research, to apply these methods and techniques, thus avoiding that these professionals "waste" time drafting their own methodology. This methodology is a work proposal that intends to reduce these risks and promote good practices of object-oriented design, for both the consumer and the environment. The methodology was based on the concepts associated with the design, user and environment which were studied and referred to in the course of this article. However, it is necessary to test it, in order to make it possible to validate its feasibility, in order to also be able to be reliably adapted to other products.

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