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ECODESIGN TOOLS

One basis to operationalize Sustainable Design

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ABSTRACT

This paper aims to provide an analysis of the different types of available ecodesign tools, their benefits, capabilities and problems, to understand how these instruments could serve as a foundation for developing a practical body for sustainable product design, thus allowing the design to be able to promote a shift to a paradigm of sustainable production and consumption.

KEYWORDS

Sustainable Design, Ecodesign, Product Design, Design Tools.

1. INTRODUCTION

Throughout history, designers have relied on a variety of tools to help them implement the design process, to integrate the wide variety of techniques and issues that they need to address and doing it in order to allow a proper product development. When we speak of the relationship between design and the environment the tools are indispensable to integrate the long list of criteria in the product development process [Byggeth06], the same should happen when you deal with all the sustainability criteria.

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2. ECODESIGN TOOLS

Product designers who aim to develop products with lower environmental impact need tools that include information, teaching items, guidance and examples that show otherwise, since they do not have enough specific knowledge about this area, are unable to integrate all the necessary environmental aspects [Lofthouse06].

According to the literature there are four objectives for eco-design tools: (1) analysis and evaluation, (2) selection and definition of priorities for improvement, (3) support the generation of ideas and design decisions, (4) coordination with other criteria [Bhamra07]. However, you can also order them by their scope: (1) focusing on a particular environmental objective, (2) product development with a lifecycle perspective, and (3) to design for eco-efficiency with integration of sustainability aspects [Vezzoli08]. The design tools can also be divided into two types: quantitative and qualitative. The first require large amounts of information and time for their use. Unlike qualitative which are simpler, require less information and time, which allows an easier integration in the internal product development. The latter are more suitable for designers despite having a larger margin of error.

Thus, given the enormous diversity of tools to support product development by integrating environmental criteria and to deepen the knowledge of its main features was drawn up a survey where 86 tools were analyzed (of which only the relevant ones are mentioned in this article): the majority (52) is of qualitative nature, of which 43 are of low complexity, instead of 27 quantitatives which are all high (10) or medium (17) complexity. Only 30 of these tools are available in software format. About half (44) has a life cycle approach, while 36 consider only a few or just one phase of the lifecycle of the product. Most relevant is the existence of only six tools that go beyond the environment and begin to address sustainability criteria.

2.1. Quantitative

The main quantitative tool is the Life Cycle Assessment (LCA) for the use of which there are already several integrated softwares, supported by databases of materials and production processes. According to ISO 14040, LCA is a tool to assess the environmental aspects and impacts associated with a product from cradle to grave, through a methodology that comprises four stages: (1) defining the purpose and scope, (2) inventory analysis, (3) Evaluation of impacts, (4) Interpretation. For the impact assessment is required (1) classify and characterize, (2) normalize and (3) evaluate [Frazão06].

Based on the methodology of LCA there are multiple variations in different software media, being more relevant to mention that their major aim is to simplify the process and make the methodology more accessible to designers and companies, particularly small and medium sized enterprises, as the examples there are Tespi, eVerdEE, PILOT, Greenfly, Durabilis and ECO-it.

Despite the many positive features, when addressed on a designer perspective, quantitative tools, particularly those like LCA, present five types of constraints [Hemel98]: (1) complexity, (2) time requirement, (3) high demand for information which is an obstacle to the participation of various stakeholders, (4) the dynamic character, which means that the results are largely dependent on a good initial setting, and (5) the difficulty of interpreting the results.

2.2. Qualitative

To counter these limitations and in order the tools can fit the need for each context there have been developments of simpler versions of a qualitative nature. Despite allowing the incorporation of various environmental criteria, as more summarized they become the less reliable they are.

In this large group we can identify four types of tools that must be examined: (1) matrices, (2) network diagrams or polar, (3) lists of strategies, and (4) checklists.

Among the matrices is one of the most used tools for ecodesign: the MET Matrix [Brezet97]. It is a table that covers the lifecycle of the product in three columns MET: (1) Materials (2) Energy and (3) Toxicity, and where the user can write the resources used by/in the product at different stages of their life cycle. This synthesis can be made based on quantitative information originating from a life cycle assessment or a more qualitative assessment. Most existing matrices are also used for impact assessment, either for existing products either for solutions under development, and/or priority setting, albeit in different ways and giving more attention to the assessment or the definition priorities. As is the case of: Dominance Matrix; Ecodesign Priority Matrix; Ecodesign Project Planning Matrix; Eco-portfolio Matrix; Product Summary Matrix [Tischner00].

Web diagrams (also known as polar diagrams) are the second type of tools widely used in ecological design, examples are: Eco-Compass; Ecodesign Web; LIDS Wheel / Ecodesign Strategy Wheel, Smart Electronics Ecodesign Strategy Wheel, Sony Polardiagram; Spiderdiagram Econcept [Tischner00]. These tools are simple and require little time. However, if they are supported by an extensive analysis of the life cycle of the product may require more time of use, which has the positive effect of increased security on the results. Graphically they are all very similar: they present themselves as a spider's web in which the various axes (usually between 5 and 8) serve to evaluate certain criteria or aspects. The combination of qualitative classification that goes on each axis allows to create an area that visually reflects the impact of the product.

Criteria or strategies put in each axis are the main variation between the different versions of the tool. There may be versions with an analysis of specific strategies a company such as Sony Polardiagram [Tischner00], or with specific strategies for a sector such as the Smart Electronics Ecodesign Strategy Wheel, or accompanying the life cycle, as is the case with LiDS-Wheel [Brezet07].

The third type includes several tools that have listing of ecodesign strategies or rules of thumb to use in the process of product development. These are generic tools such as 10 or Guidelines for Ecodesign or Econcept Strategy List, which means that are wider and less focused, or that allow for customization such as the Expert Rules, Rules of Thumb; Ten Golden Rules [Tischner00]. They are very simple tools that require little time to use, but if they are geared to a specific company or sector require preparation time.

The fourth typology includes checklists that are usually more extensive and comprehensive listings that display strategies and allow a small evaluation of each criterion listed. They are arranged in a table setting, detailing various criteria in each category, whether these are design strategies or life cycle stages. These tools may require some time of use depending on their length, but also allow an educational activity due to its content. The variation of the content may be wide, but there are two commonly used models for analysis and verification: via an alphabetical sort as in the case of ABC Checklist [Frazão06] or by a classification with signs +, + / -, and Ø such as the Ecodesign Checklist [Tischner00]. There are also cases of checklists for a specific business context such as the Fast Five Phillips or Volvo's Black List. These cases benefit from some simplification due to its focus on a specific activity, which is beneficial for use in a dynamic and demanding in terms of time as the business environment.

3. IN THE SCOPE OF SUSTAINABILITY

As mentioned above, a survey and analysis has identified six ecodesign tools that go beyond the strict environment scope and incorporate sustainability criteria. These tools are based on methodologies used in ecodesign, extending its scope.

The quantitative tool in this batch is the Life Cycle Assessment Social (S-LCA) that has an approach similar to LCA [UNEP09] and can be used as a complement. Another tool is the quantitative SPI System (Sustainability Performance Indicators System) [Fiksel01] used to select environmental, economic and social indicators, to identify the needs of stakeholders, to identify the most relevant aspects of products and the definition of objectives.

In a more qualitative approach we MSPD (Method for sustainable product development) [Ghazilla08] a method which is composed of three modules: (1) module for product development, which aims to connect with the design process, (2) module for assessing the sustainability of the product which is characterized by a series of questions that lead the team to consider the relevant criteria, and (3) prioritization matrix. On the other hand, SDO Toolkit (Sustainable Design Orienting Toolkit) [Vezzoli08] is a simplified approach of assessing the life cycle, but also includes the evaluation of social and economic component, supporting the prioritization and development of new ideas. This is done based on a checklist that covers the various criteria considered relevant to the user and giving space to incorporate proposals for improvements in the solution to develop. There is also the Sustainability Circle [James97] that uses a color-coded rating system based on several criteria divided into four large circles: (1) value for the customer, (2) physical impacts on the environment, (3) attributes of the product and (4) social impacts. Another example is the Protocol Cyclic-Solar-Safe, a development and evaluation system of products based on five design criteria: (1) cyclic, (2) Solar, (3) Safety, (4) Efficiency and (5) Social [Datschefski99].

4. CONCLUSION

The different approaches to design with environmental concerns led to the development of tools targeted at only one aspect or phase of life cycle, as is the case of cleaner production tools, but also the development of more comprehensive tools that address the entire product life cycle, as is the case of life cycle assessment. Just as these developments occurred within the practice of ecodesign, we have been witnessing in recent years to developing of tools that integrate all relevant aspects in the context of

sustainability, considering not only environmental criteria, but also economic and social criteria, it is important to note that the eco-design tools can serve as a platform for this development, thus contributing to the operationalization of sustainable design.

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