

Sustainable Design: A furniture focused approach

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Abstract:

The research project presented in this paper intends to develop tools that product designers can use in their work in order to enable a more sustainable outcome. The project is based on the principle that sustainable design is the next step for ecodesign, because, besides the economic and ecologic values, it includes all aspects related with sustainable development, and aims to turn this principle into a more practical and workable subject.

Based on the conclusions of several authors that principles, strategies and tools have a best performance when oriented to a specific kind of product, the project focuses its approach on a specific sector: domestic wood furniture.

This paper presents the state of the art of the overlap in product design methods, ecodesign tools, furniture products life cycle information and sustainability. Furthermore, this paper will also discuss the possibility of reaching a sustainable design practice in this sector through a focused approach.

1. INTRODUCTION

The integration of environmental knowledge in the product development process is a key factor for the achievement of sustainable production and consumption patterns. Nevertheless, this integration is not enough. Sustainable Design has mainly a theoretical and philosophical body (Walker, 2006), with only a few practical components inherited from Ecodesign (Tischner, 2001). Acknowledgement of these two statements can be the basis for the design community to work upon: the design process has to encompass all criteria inherent to sustainability and needs to do it in a quick and practical manner.

Another critical element is the mandatory increase of efficiency in the use of energy and material resources that both the design process and the product system need to achieve. A way to promote this is through the study and development of specific strategies and tools focused by sector of activity, that are based on the life cycle assessment of that product range (Hemel, 1998).

The research project *“Contributions to a sustainable design methodology applied to the furniture industry: the Portuguese Case”* addresses these factors in an integrated way. In this paper we will present the objectives and the methodology for this research, discussing the steps needed for the evolution from Ecodesign to Sustainable Design and presenting the improvement of a design tool as an example. Furthermore it will be discussed how a sector focused approach can contribute to a sustainable design practice.

2. RESEARCH PROJECT

The goal of the research project *“Contributions to a sustainable design methodology applied to the furniture industry: the Portuguese Case”* (www.designsustentavel.org) is to contribute to the paradigm shift towards sustainable production and consumption patterns. To do so, we intend to develop tools that will allow the designers and companies from the wood furniture sector to achieve a more sustainable performance. We hope to answer the question: Is it possible to develop sustainable design tools which promote the development of the Portuguese wood furniture industry?

We have identified sustainability, design and furniture as the three main subjects that need to be addressed and their crossover should be studied.

The first is being studied to understand its main philosophy, principles and criteria, so that we can relate them in a practical manner to design.

For the second we're studying the development of ecodesign, mainly its tools and strategies, to understand how and where in the design process it is possible to introduce improvements that bring together the sustainability criteria and the furniture sector needs.

For the latter, and so that the tools and strategies developed are effective and practical, we are analysing the wood furniture life cycle, understanding the design processes already in use and looking for potential windows of opportunity. This will also enable a framework for the strategies and tools to be developed.

The methodology which was designed to implement this project is presented in Fig. 1. It is divided in three stages. The first is a theoretical one and concerns literature review on the three areas identified above and the analysis of ecodesign case studies in the furniture sector. This paper presents the work developed in this first stage and in part of the next one. The second and third stages are empirical. They encompass a survey, a set of interviews and the development of case studies. The survey is pointed at the furniture companies to understand their design process and their relationship with sustainability. The interviews are intended to consult ecodesign and sustainable design experts in order to gather critical information

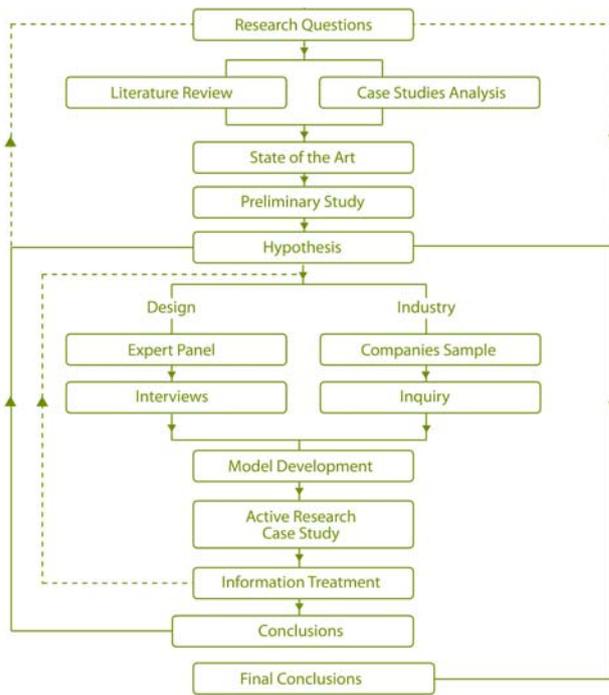


Fig. 1 – Research Methodology

about the main problems (and the main paths to solve them) which a focused approach on this sector should address.

After the analysis of this information a model will be developed where strategies and sustainable design tools for this sector will be incorporated. This model will be tested in some furniture companies and reported in case studies.

After this information has been analysed, it will be sent to the expert panel for validation.

From the first theoretical stage of information gathering and analysis we can already present some data to contribute to the discussion on three subjects: the

evolution from ecodesign to sustainable design; the improvement of a sustainable

design tool; and the advantages of choosing a sector focused approach.

3. FROM ECODESIGN TO SUSTAINABLE DESIGN

Since the late sixties, the design activity has been changing and growing, embodying environmental criteria in its process. At the beginning, in a not so much integrated way, by the first level of environmentally responsible design known as green design, where the focus was only on a specific impact of the product (Dewberry, 1996).

Ecodesign evolves on from this basic design approach to address environmental impacts across the complete life-cycle of the product, from production to disposal (Dewberry, 1996). With the development of life-cycle thinking and integrated environmental management tools it was possible to create a holistic approach in which the environment would help to define the design decisions with the same importance as any other traditional design criteria (Brezet e Hemel, 1997).

Ecodesign has based its capacity to develop practical work on the ability to integrate and synthesise the information on the types of environmental problems and how the business are driven to overcome that problems. This is possible by the use of trade-offs when implementing ecodesign strategies and with a wide view of all life-cycle. Also, ecodesign development has been sustained by the creation of information, strategies and tools that enabled the designer to: analyse the environmental strengths and weakness; to set priorities helping to select the improvements with best potential; to support the idea generation; and to enable a efficient relation with other criteria (Tischner et al., 2000).

Therefore, ecodesign is a field that has become essential to the design area, fulfilling two main goals: enabling an easy integration of environmental consideration in the design process and helping the development of information that allows a truthful assessment of the environmental load of a product or system (Bakker, 1995).

Nevertheless the sole integration of environmental criteria in the design process is not enough to promote a shift to sustainable development. An ecodesign strategy does not go so far as to analyse the social questions inherent to a product-system. Something a sustainable product design approach aims to do (Dewberry, 1996). So, ecodesign will not conduct us to environmental sustainability, and even less, to sustainability as a whole. Since ecodesign is already being used by companies, what is missing are methods and tools that integrate social considerations (Charter e Tischner, 2001).

We should also consider that neither a strategy of efficiency, nor a strategy of sufficiency by them self's should be feasible to obtain the necessary improvements in production and consumption system (Vezzoli e Manzini, 2008). Therefore, a joint strategy which enables us to deal with the much needed increase of efficiency but also addresses all the relevant social aspects is required.

For this to be practical it is necessary to address the problem from a sustainable design point of view, which should be a development process of products and services that takes into account all aspects of sustainable development, therefore being one step ahead from ecodesign (Armstrong, 1997). Sustainable design includes, alongside with economic and ecological issues, considerations of social issues in the entire life-cycle such as usability, social responsible use, sourcing and designing to address human needs (Bhamra e Lofthouse, 2007), rather than human desires.

The current development model is assessed by the amount of goods manufactured and consumed and by the ability of creating economic growth. So, there is the need to shift towards a new model, based on the development of human life-quality and, although it is not clear how to make this shift, this will require the involvement of all structural dimensions: physic, energetic, economic, institutional, social, ethic, aesthetic and cultural (Vezzoli e Manzini, 2008). This poses several challenges that are reflected in the design activity, like the ability and sturdiness of the design process to embody the element of the sustainability triple bottom line that still posses greater difficulties: social progress (Charter e Tischner, 2001).

In order to understand what should be added into the design process so that we can call it sustainable, we need to remind the considerations needed to be addressed by design in the three pillars of sustainability (Fig. 2).

Economic Issues	Environmental Issues	Social Issues
Technological feasibility	Water minimisation	Fair trade
Financial feasibility	Cleaner manufacturing	Equitable policies
Short and long term profitability	Cleaner materials	Good employment
Adequate pricing	Eco-efficiency	Conditions of work
	Less materials	Investment in communities
	Less energy	Support for regional economy
	Renewable resources	Cruelty free
	Renewable energy	Satisfaction of real needs
	Recycling	More customer value
		Better systems
		Gender equality

Fig. 2 – Sustainable Product Design Concerns (Adapted from Charter & Tischner, 2001)

Since both economic and environmental issues have been widely discussed in the past we shall focus our attention on the the social issues, in an effort to understand how to select the relevant aspects to design and to the furniture sector.

Note that all aspects of sustainability are relevant to the work ahead, but we believe that at this moment a special attention should be given to the third pillar, the social progress. Due to the lack of attention it has received so far, we could argue that it's lagging behind the other two.

SOCIAL RESPONSABILITY CRITERIA (without environment)		NP4469-1	SA8000	GRI G3
Org. Manag.	Information, consultation and stakeholder participation			
	Corruption and bribery / extortion			
	Shareholders, suppliers and clients relations			
	Management systems			
Human Rights	Right to life and freedom			
	Right to work and decent working conditions			
	Diversity			
	Non-discrimination			
	Gender equality			
	Rights to maternity and paternity			
	Rights of children: life, survival and development			
	Indigenous and ethnic minorities rights			
	Rights of migrant workers			
Labour Practices	Child Labour			
	Forced Labour			
	Security of employment			
	Termination of the employment relationship			
	Working time / hours / holidays			
	Social security			
	Freedom of Association and Collective Bargaining Agreement			
	Freedom of Association and protection of trade union rights			
	Disciplinary Practices			
	Remuneration and financial benefits			
	Sexual or moral harassment			
	Occupational health			
	Hygiene at work			
	Safety at work			
	Professional diseases			
	Accidents at work			
Operational Practices	Training			
	Suppliers subject to assessments			
	Partnerships for development of new products			
	Fair competition			
	Contribution and involvement in political			
	Mutual development and synergies with suppliers			
	Technological innovation for sustainable development			
Respect for patents, copyrights and intellectual property				
Consumer	Health and safety of consumers			
	Information			
	Satisfaction of needs and expectations			
	Quality of goods and services			
Society Development	Social activities			
	Public health / welfare			
	Support to local community development			
	Involvement with community			
	Conditions that affect / improve neighbourhood welfare			
	Local recruitment			

Fig. 3 – Social Responsibility Criteria

Several independent organizations have developed guiding principles and criteria that help companies address their problems, how to work on a solution and how to report that evolution. We'll address here some standards and criteria considered as reference in the social responsibility area.

By the cross reference of the Social Accountability 8000 Guidance Document, the Portuguese Standard on Social Responsibility Management System NP-4469-1 and the Global Reporting Initiative G3 Performance Indicators we can identify the most relevant issues and select some criteria as having more importance to this industrial sector and with more potential for a practical relation with the design process (Fig. 3). We should keep in mind that some social issues often fall under the range of other design approaches such as inclusive design or design against crime and that other are outside the remit of the designer (Bhamra e Lofthouse, 2007).

This selection was run by the furniture sector, through a survey, and we can say by a first analysis that they consider relevant or very relevant the issues presented in Fig. 4.

Social Issues
Non-discrimination and gender equality
Freedom of association and collective bargaining
Time and working hours
Stability of employment
Compensation of employees
Health, hygiene and safety
Staff training
Selection and evaluation of suppliers on criteria of sustainability
Respect for intellectual property
Technological innovation for sustainable development
Information about content use and maintenance of products
Support and involvement of local communities

Fig. 4 – Social Issues considered more relevant by Furniture Companies

From these results we can say that companies have given more importance to issues related to labour and operational practices, but without ignoring Human Rights, Consumer or Social Development issues.

4. SUSTAINABLE DESIGN TOOLS

Based on the experience from ecodesign we can point out the development of tools, with the information and strategies that support them, as a key element for the practical implementation of this activity. Therefore we can assume that for a sustainable design approach a similar path should be taken. We should first take an overlook on the design process to understand where the sustainable design tools can be used.

4.1. Design Process

The goal of a design methodology is to explain how designers think and develop methods that turn the design process more efficient and effective (Bakker, 1995). This is done in a systematic manner and by synthesizing the necessary steps with the considerations that should be taken into account in each phase. The Pahl & Beitz model, Fig. 5, is often presented in the design process literature, specially in the literature related with ecodesign (Brezet e Hemel, 1997, Bakker, 1995, Dewberry, 1996) .

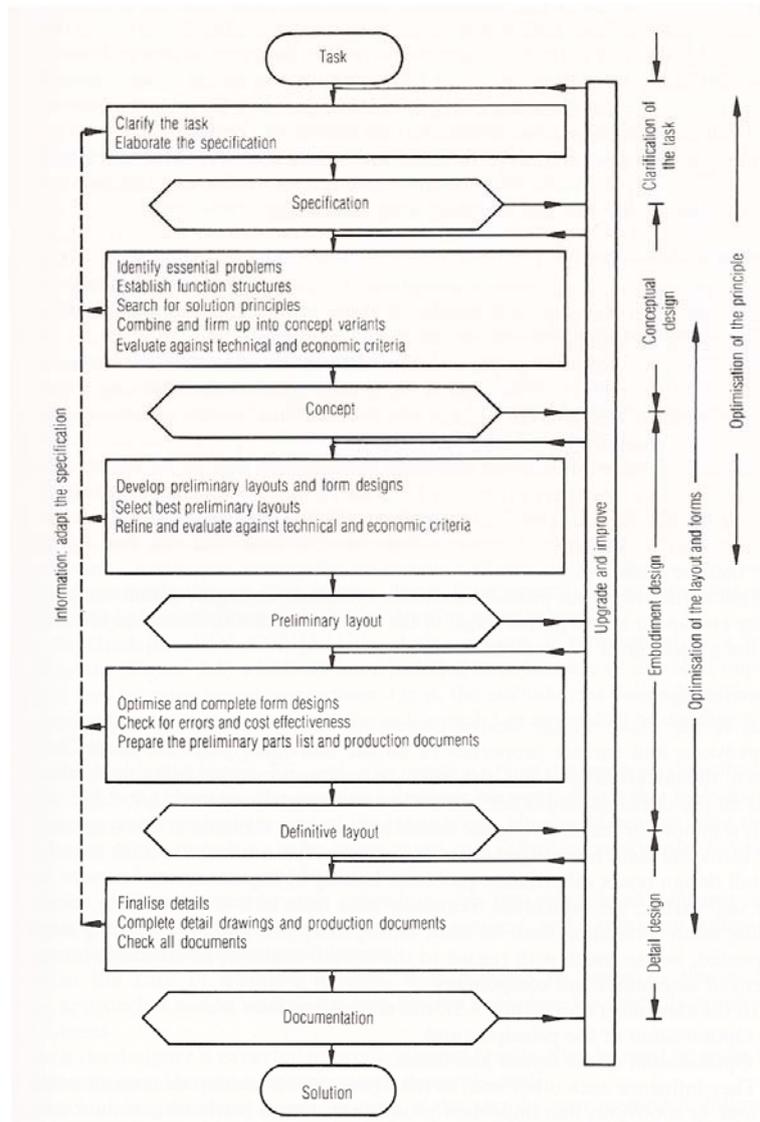


Fig. 5 – Steps of the design process (from Pahl & Beitz, 1992)

The ecodesign consensus model (Bakker, 1995), Fig. 6, which was developed based on a cross examination of several models with the purpose of enabling the design process to consider environmental information, is more focused on the first three steps of the Pahl & Beitz model, because they are the steps that present more potential for product improvement, namely on environmental aspects.

We should also consider that, in practice, the application of any model seldomly happens in such an organized and linear manner (Dewberry, 1996). Due to several external or internal influences the process can become much simpler or, as an opposite, much more twisted. This is relevant due to the importance stakeholders have in a sustainable context and the role they can play on the active shaping of the product development process.

The above-mentioned can be translated and applied to all sustainability considerations. Therefore, a sustainable design approach should take similar steps and a sustainable design tool box should also focus mainly on 4 phases presented on the ecodesign consensus model (Fig.6). Also, we should choose those tools that were developed considering the necessary modifications for widening the scope from

environmental to sustainable (Bras, 1997). This toolbox also needs to be associated with a sustainability information matrix for support.

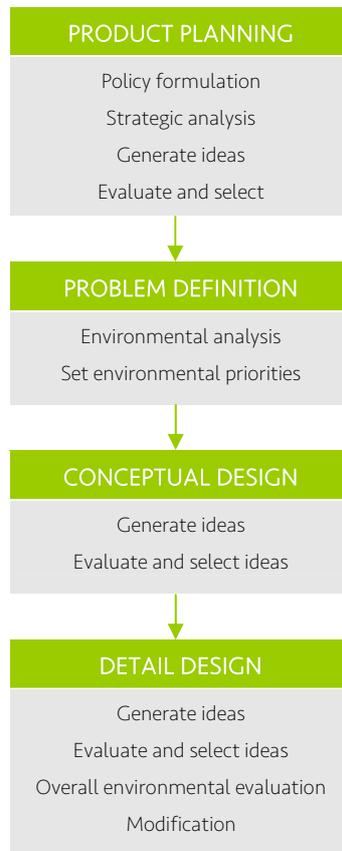


Fig. 6 - Ecodesign consensus model (from Bakker, 1995)

4.2. Sustainable Design Tool – Seeed Matrix

Nowadays qualitative and simpler tools for designers and companies tend to become easier to be integrated in the product development process without a great business disturbance (Fiskel, 2001), or large investments, which is very important for SMEs.

Therefore, it will be presented an example of a sustainable design tool, which is an evolution of the eco design tool MET-Matrix.

The MET Matrix is based on the input-output analysis of Materials, Energy and Toxicity, which MET stands for. This tool enables to present a global inventory of the main problems and it can be used to define the environmental profile of a product system, through five life stages (Brezet e Hemel, 1997). This synthetic inventory can be used to analyse the product system weak points and to identify potential environmental improvements. By helping to determine the environmental weight of a product and by supplying information in a clear manner this tool dwells in the boundary between the first two purposes defined by Tischner et al. (2000) and presented earlier in point 3: analysis of environmental strengths and weakness; setting priorities and helping to select the most potential improvements.

With the same purposes, but with the entire scope of sustainability in mind, it was developed the Seeed Matrix, Fig. 7. Its name reflects the integration of the three “E’s” of sustainability in a sustainable design approach. The five rows still represent the five stages of the product life cycle, but in a more simplified

manner, so that the entire tool wouldn't become too complex. Each of the three columns addresses a sustainability pillar and is sub-divided in two. On the left column it is represented the economic issues, which, although already a highly embedded issue on the design process, it should not be discarded for a wide view analysis. This column is divided in a simple cost-benefit analysis for each life-cycle stage. The environment column reflects a simpler version of the MET Matrix, combining the materials and energy on the Resources sub-column. The main innovation is the third column, which represents the social pillar. It

	ECONOMY		ENVIRONMENT		SOCIAL EQUITY	
	Cost	Benefit	Resources	Toxicity	Internal	External
Pre-Production						
Production						
Distribution						
Use						
End-of-Life System						

Fig. 7 - Seeed Matrix

is sub-divided in internal and external issues. Being the internal issues all that are related with the company and pre-products or products responsible at any given stage. For example the company and their workers on the production stage, the same for the suppliers on the pre-production, on so forth for the distribution and end-of-life system. On the use stage it should be considered the social impact on the user. The external sub-column reflects all the impact the product will have on the other stakeholders, like the local communities, business organizations and so on. Any of these columns or rows can be subtracted or, if necessary, further developed, depending on the product being addressed.

5. SECTOR FOCUSED APPROACH

The tool presented above is intended for a wide spectrum use, meaning, for any type of sector the design reaches. Nevertheless, it can be adapted to a specific sector. For this to be effective a deeper understanding of the sector in study has to be reached.

Achieving relevant results on sustainability by the design activity is a complex task, on which the efficiency of different strategies depends largely on the type of industry we're addressing (Hemel, 1998). Therefore, the best way to establish a profitable connexion is to focus our work on a specific range of products. By doing this, it is expected to reduce the environmental and social load of the product system and contribute to the shift towards a sustainable production and consumption.

As mentioned earlier, this research is focusing on Portuguese wood furniture products. This product range has, as any other, some specific features and particularities that shape their life-cycle. Wood furnitures are a part of the forest range of products, which are highly recyclable products, act as carbon sink and are low energy demanding through the entire life-cycle (BCSDPortugal, 2006).

The use of wood presents several opportunities for design. The forest of origin moves great influence on the impact of the material chosen. A sustainable managed forest, especially near the production site, offers a positive weight on the sustainability load of the product, whether a forest harvested without any principles, might they be of the forest itself or the surrounding populations, has a very negative influence on the product impact. One other significant feature is the fact that this range of product does not consume energy in the use stage.

Based on an international project on wood furniture (CSM, 2006) and on the information developed for the European Ecolabel furniture categorie (CREM, 2002), we can state that the major impact happens on the production stage (around 50%), seconded by the pre-production stage, which, depending on the material used it can go up to 30%. This material choice will also influence the impact on the end-of-life stage, which is greatly influenced by national policies. The distribution stage presents itself as the same weigh as in the majority of industries, but the use stage has an impact close to zero on the product life-cycle, except in the case where toxic compounds are used in resins or glues, which can be passively released during use.

It should also be considered that this industrial sector is mainly composed of small and medium size companies, more than 60% (CSIL, 2007) and, although recent improved technological incorporation, is highly intensive on human labour (CREM, 2002). The furniture sector is well adapted inside the wood cluster, allowing the creation of an industrial ecosystem, where all waste is used by other industries of the cluster.

So, this sector and a sound forest management are higly inter-dependent, because of this (and the adverse social impacts an ill managed forest can represent) and the high use of local human resources on depressed rural areas where these industries are the main employers, the design decisions on the product development will have a large influence on the social progress.

With this small analysis whe can revisit the Seeed Matrix, adapting it to this sector (Fig. 8):

		ECONOMY		ENVIRONMENT		SOCIAL EQUITY	
		Cost	Benefit	Resources	Toxicity	Internal	External
Pre-Production	Materials						
	Components						
Production							
Distribution							
End-of-Life System	Re-use						
	Disposal						

Fig. 8 - Wood Furniture Seeed Matrix

The main diference is on the removal of the use stage and on the inclusion of more detailed stages on pre-production and end-of-life system. The Pre-production stage is divided into Materials and Components. The first addresses the type and origin of the materials that come direct to production or go to pre-production and the second addresses the suppliers, their attitude and the products. On the

End-of-life system stage the split was made to address the potential of these products to be re-used, therefore extending their life-cycle and the time they act as carbon sinks.

6. CONCLUSIONS

The aim of this paper has been to state a possible evolution from ecodesign to sustainable design. It has been identified the social progress as the main focus to be addressed so that this evolution can take place and be implemented in a practical manner. To help this integration, several social criteria have been analysed and selected. It has also been presented a design tool evolution as an example of the modifications needed to be done on the design toolbox to enable a practical use of sustainable design. Also, to promote this adaptation, a focused sector approach presents itself as an efficiency enabler for a sustainable design approach and its toolbox.

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