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Development and Proposition of a Tool to Evaluate the Ecological Identity of Products: Furniture Case

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ABSTRACT

This paper focuses on the quest for the ecological identity in furniture design. From a historical point of view in the last century, the evolution of furniture products has been examined through some examples that paved the way for clear identities by including some apparent design features. By this review, the first furniture products were spotted that could be representatives of an eco-identity. In the literature, investigation of recent eco-strategies, considering product life cycle and also product-service system approaches ended up as a list of criteria to evaluate eco-products. As a result in this paper, a checklist model was proposed and visually presented in order to assess and choose products with this regard to the eco-identity. This proposition of checklist is a re-interpretation by altering an evaluative method in design process. This tool was used to assess and compare 6 different eco-furniture products that are presented in ecodesign books.

Key Words: Product Identity Ecological production Sustainable product lifespan

1. INTRODUCTION

In order to comprehend a product's identity with eco-friendly characteristics, Gotzsch (2008) offers a model of the key aspects for the attraction of ecological products. However, there are still questions to be conceived. The query is whether or not there are ecological codes that can be easily understood? What are the criteria to form such an apparent eco-identity?

As to research method, the effect of material selection will be evaluated together with new production techniques and will have an important place in this study. The selection and use of materials in industrial products are determined according to many parameters such as production method, cost and aesthetics. The contribution of materials is crucial in order to embody product identities in some product categories that establish emotional bonds with users such as furniture.

2. RESEARCH

In the history of product design, before the definition of 'ecological design' had not yet been established by first examples in the early 1970s, it may be a proper suggestion to regard "Arts and Crafts" movement and William & Morris furniture as the foundation of ecological design. Although the term 'ecological design' had not been defined yet, the ideas and discourse behind these designs are remarkable since they formed as a reaction against cheap production of industrialization at the end of 19th century. During this period, Ruskin examined the relations between art, society and the working class and Morris put Ruskin's ideas into practice so opposed the way of production and heavily imitative materials and style of furniture at that time. On contrary, the natural beauty of materials and the value of craftsmanship are highlighted.

This individualistic design initiative, started by Ruskin and Morris, had followed by the style of Art Nouveau conveying the traces and effect of Romantic Era (Şen, 2014). In this period, organic shapes and forms inspired by nature were visible in furniture products.

As the result of industrialization, the structure of society and consumption habits had changed completely. Mass production in large quantities, inexpensive and fast production, transformed the design and use of products. By introducing steam bending as a new production method, Thonet chairs could achieve a distinctive identity due to its form features. The parts of the chair that were mass produced on the assembly line could be easily identified and marked as Thonet production by the properties of its form.

New materials and production techniques had developed after the First World War and led to aesthetics of 'Machine Age' and pioneering approaches in design. Inspired by the art movements and cultural change of this period, pioneers had come up with designs that embody their ideological approaches. As a leading representative of the De Stijl movement, G. Rietveld designed the Red Blue chair (1918) which is like a three-dimensional installation that reflects the abstract and geometrical form of the movement. The chair was composed and manufactured of standard wooden parts easily available at that time to be produced in series.

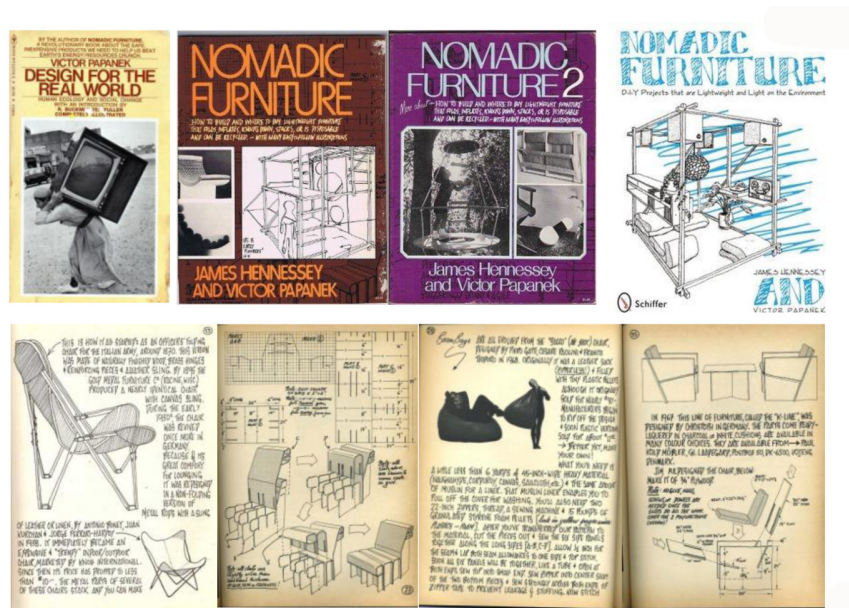
This minimalist approach continued in the Bauhaus design school in Germany and laid the foundation of modern design. The main intention was to combine all arts with technique by rejecting ornament and to derive the form from the function through simple shapes. M. Breuer considered a chair that could be produced on a serial assembly line as if Ford Model T in the automobile factory. His design, the 'Wassily' chair (Model B3) was the first design (1925) that consists of tubular steel. Later, designers such as M. Van der Rohe and A. Aalto continued to incorporate new production techniques.

The Second World War is another turning point that introduced new materials and production methods such as development in plastics and fiber-glass. After the stagnation of wartime, some original designers and manufacturers could benefit from the developments in the defense industry and transformed furniture products. During this period of rising prosperity in the USA, innovative designers and producers such as C. & R. Eames, R. Loewy and H. Miller stepped forward. First design attempts of C. & R. Eames resulted in DCW and LCW chairs (1946) made of plywood. These were comfortable chairs with a wide seating surface and a robust, durable structure, designed to meet the requirement of light, compact and low-price furniture for young families of rising population. Their experiments with the new material, glass-fiber led to a family of chairs named LAR, DAR and RAR (1948). These chairs are still design icons that provide lightness, ease of use and cleaning while their steel legs and wooden feet can be changed, assembled and disassembled on the glass-fiber body.

This way, social effects of World War II decreased through the technological innovations. In 1950's, people started fostering hope in a rapidly developing society. This optimistic view brought a period of interest in more moderate, pastel colors and organic forms made of natural materials such as wood. This organic modernism gave direction to furniture design by the pioneers such as C. & R. Eames in USA and A. Jacobsen in Europe. In Italy, Castiglioni

brothers introduced the first examples of recycled 'ready-made' designs. Sella stool (1957) was designed by converting a bicycle saddle into a seating unit that provides free movement in all directions and intended to be used in telephone booths.

As the modernist movement, dominated by organic forms, continued in 1960s; a few designers who were against the rational values of modernism set the scene for extraordinary furniture designs which were mostly different type of plastics by new production techniques, especially in vivid colors and fluid forms. By 1970s, the scene changed again as the cultural and social situation had become pessimistic due to a polarized world, wars and political scandals together with negative effects such as global oil crisis, increasing unemployment and inflation. This change in socio-economic conditions also improved the perception of design in a direction; sensitive to social issues. Therefore, the first examples of design responsible of social and environmental concerns appeared by the studies of V. Papanek (Papanek, 1971, 1973). The ecological identity of furniture design started to appear by these approaches aiming at materials in light, efficient and recyclable forms (Figure 1).



[Figure 1] First examples of ecological identity in furniture design

Decades after this introduction in today's world, daily human life has completely changed by information, communication and transportation technologies. Consequently, there is need for diverse furniture designs that are suitable for the changing lifestyles and identities of users of different social and cultural background. The environmental effects of this rapid lifestyle and consumption habits inevitably put a strain on the concern for sustainability.

Ecological and sustainable design approaches have become very important in recent years considering the environmental pollution and risks which are increasing day by day with industrial development. As the interest of public in this matter has risen due to climatic changes, research and information towards eco-products and eco-design strategies aggregated through articles and books.

Thus, during this study in order to identify the leading criteria for ecological identity, different books and sources over ecological design have been examined (Fuad-Luke, 2010; Bhamra et al., 2013; Liu and Wong, 2013; Vezzoli et al., 2014; Proctor, 2015). Beside sets of criteria according to life cycle assessment in these sources, ecological evaluation of chosen products can be seen by the criteria determined in some sources. It is seen that ecological evaluation has taken place in the product descriptions often by writing material information briefly together with related ecological terms and methods or by expressing these methods via associated symbols shown next to products.

The aim of this study is a more measurable evaluation and comparison between products. Therefore, the main criteria for evaluation are determined as a result of searching the headings of chapters in ecodesign books and by examining the methods of sustainability in the literature. The criteria have been categorized under three main phases: production, use and end of life in order to correspond to product life cycle stages. The relevant criteria to be used for the evaluation, comparison and selection of eco-products are as follows:

- Production:
- Material Economy (No waste & Reduce Resources)

Natural Materials (Low-impact & Biocompatible)
 Technology (Production methods & Optimization)
 Crafts (Local production & Social contribution)
 Use:
 Product Service System
 User Perception & Awareness
 User Lifetime (Durability, Product-user relationship & adoption)

End of Life:
 Reuse & Recycle

In the production stage; material economy indicates the consumption of material resource being used; the amount of energy needed for these materials and their production containing the necessary labor force or machinery. This can be called as embodied energy. Natural materials are raw materials obtained from the biosphere or lithosphere on earth. They are not transformed by technological processes so cause little environmental impact and they can biodegrade in nature. This way, materials can be compared according to their embodied energy. Technology incorporates the ease and efficiency of the production method with total number of production phases, workforce and the amount of energy consumption. Harmful substances or gases emitted during the production method and phases are considered in this criterion for the proposed model. Crafts mean the level of local production and labor force and social contribution to the region where it is produced. Fair trade can be considered in this criterion.

As to use, product service system approach indicates the degree to what extent the product and business model are designed together as the product is evaluated together with its infrastructure and the system if it's applicable. Logistics, packaging and distribution are considered in this criterion. User perception and awareness means the level of increase in the ecological awareness of the user as a result of the product usage embracing material experience, usability and interaction with the user. User lifetime corresponds to the durability of the product due to materials and production method as well as the product-user relationship which can extend its life span. Functional and aesthetic features that can increase its user adoption are rated in this criterion.

In the final stage, the suitability of the materials for recycling and reusability is taken into account to rate this criterion while comparing the product samples.

For the evaluation, the samples were chosen among chairs as a product category which is more functional in furniture products. With regard to the criteria of use and product lifetime, product-user relationship is the major issue of seating products in terms of functionality. For selection of the chairs to be evaluated by the specified criteria, a search has taken place in ecological design books. Among the chairs having common reference in these sources, eight outstanding chair designs of different materials were chosen and rated by a checklist tool formed out of these criteria (Table 1). Similar evaluative profiles (Harris profile) are used in the conceptual stage of the design process in order to rate different product alternatives according to design requirements (Langeveld, 2007). As a result, the most appropriate conceptual solution can be chosen by comparing the total ratings set by the design specification.

1	Material Economy			
2	Natural Materials			
3	Technology			
4	Crafts			
5	Product Service System			
6	User Awareness			
7	User Lifetime			
8	Reuse & Recycle			
T				

[Table 1] Table for the evaluation of eco-products

In this table, the chairs are rated according to eight steps that are arranged according to the ecological design criteria. For each criterion during the product life cycle, parameters such as the amount of embodied energy required for the materials and production method together with labour need of the design, product service system involving distribution, the way of use, usability and interaction with the user so its adoption and durability, end of life are compared and rated. The criteria were rated on a three-grade scale by comparing the design parameters among the selected samples. Six out of eight products rated in this study can be seen in figure 2.

Eco Chair, Iform (Fuad-Luke, 2010, IF Ecology Design Award 2000)
Materials and production: Plywood, compression molding



1	Material Economy	■	■	■
2	Natural Materials	■	■	■
3	Technology	■	■	■
4	Crafts	■	■	■
5	Product Service System	■	■	■
6	User Awareness	■	■	■
7	User Lifetime	■	■	■
8	Reuse & Recycle	■	■	■
T			14	

Pressed Chair, 2011 (Liu & Wong, 2013)
Materials and production: Aluminum plate (2.5 mm), cutting, pressing and bending



1	Material Economy	■	■	■
2	Natural Materials	■	■	■
3	Technology	■	■	■
4	Crafts	■	■	■
5	Product Service System	■	■	■
6	User Awareness	■	■	■
7	User Lifetime	■	■	■
8	Reuse & Recycle	■	■	■
T			12	

Ikea Vagö, 2000 (Fuad-Luke, 2010)
Materials and production: Polypropylene, monobloc molding



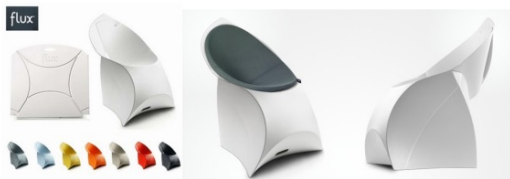
1	Material Economy	■	■	■
2	Natural Materials	■	■	■
3	Technology	■	■	■
4	Crafts	■	■	■
5	Product Service System	■	■	■
6	User Awareness	■	■	■
7	User Lifetime	■	■	■
8	Reuse & Recycle	■	■	■
T			10	

Hemp Chair, 2011 (Proctor, 2015)
Materials and production: Hemp-fiber composite material, compression molding by water-based resin



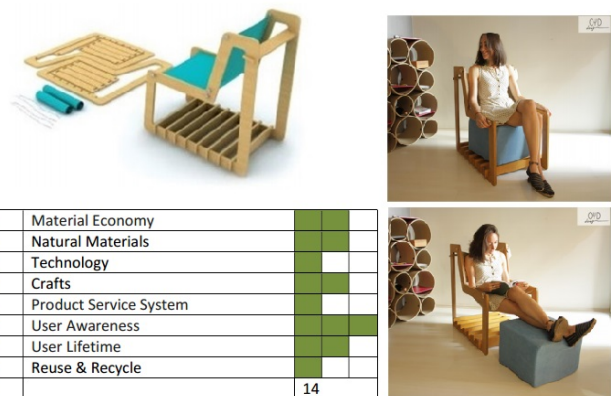
1	Material Economy	■	■	■
2	Natural Materials	■	■	■
3	Technology	■	■	■
4	Crafts	■	■	■
5	Product Service System	■	■	■
6	User Awareness	■	■	■
7	User Lifetime	■	■	■
8	Reuse & Recycle	■	■	■
T			14	

Flux Chair, 2010 (Liu & Wong, 2013)
Materials and production: Polypropylene sheet, injection molding



1	Material Economy	■	■	■
2	Natural Materials	■	■	■
3	Technology	■	■	■
4	Crafts	■	■	■
5	Product Service System	■	■	■
6	User Awareness	■	■	■
7	User Lifetime	■	■	■
8	Reuse & Recycle	■	■	■
T			11	

FS Chair, 2011 (Lucas, 2013)
Materials and production: Plywood, organic fabric and rope, assembly without screws or glue



1	Material Economy	■	■	■
2	Natural Materials	■	■	■
3	Technology	■	■	■
4	Crafts	■	■	■
5	Product Service System	■	■	■
6	User Awareness	■	■	■
7	User Lifetime	■	■	■
8	Reuse & Recycle	■	■	■
T			14	

[Figure 2] Ratings and comparison between the design samples

3. CONCLUSION

This tool proposes an evaluative model for the comparison and rating of eco-products. 3-grade scales offer an estimation of each criterion as the parameters related to that criterion were considered and compared for the chosen samples. By eight criteria, products can be compared and rated approximately with the aim of reaching an

overall score for every product. These ratings for each criterion are based on the author's consideration for the product design over its life cycle. However, its accuracy can improve when it is used in a focus group of designers and experts. This way, an average score can be obtained according to the number of participants.

As this tool may be usable for the conceptual evaluation of eco-products in the design process; it is good to keep in mind that design parameters which must be taken into account for the criteria associated with user stage of life cycle (PSS, user awareness and user lifetime) may vary for different product categories. In this case, chair design is a product category which is supposed to be highly durable while users tend to adopt seating products more emotionally rather than others in furniture category. Consequently, this research was conducted as a part of the phd. study which is currently going on and aiming at contribution to the lifespan of eco-products.

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