DESIGN FOR SKIN & SHAPE IN THE PACKAGING INDUSTRY

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Abstract: *Over the years a number of Design for 'X' methodologies have been presented by a variety of researchers. The main idea behind these proposals was to stress one particular design issue over the others. Although all issues should be considered simultaneously, while designing a new product, sometimes there is a need to pay more attention on only one of them. Traditionally, the researchers dealt with the design of products and manufacturing and/or assembly were the first issues brought into attention related to the Design for Manufacturing and Assembly methodologies. The area of modern packaging design is traditionally treated in a similar manner with product design. Although this is not a mistake, there is a gap in creating a novel design methodology exclusively for the packaging industry. The proposed Design for Skin and Shape (Df S&S) methodology is stressing the idea that the user of a product should understand clearly, which product is held in the proposed packaging by the packaging design itself. A series of case studies is presented in order to establish the advantages of the proposed methodology.*
Key words: *Design for X, Design for Skin & Shape, packaging design*

1. INTRODUCTION

The Design for X methodology refers to the use of a formal way in order to optimize a specific aspect of the design process. The first methodology of this kind was the Design for Manufacture and Assembly (DfMA), which was originally introduced by Boothroyd and Dewhurst, in order to encompass their approach to ensure that a product is both easy handled from the manufacturing point of view and at the same time simple to assemble (Baxter, 1999; Boothroyd, 1994).

Although all aspects of the design process are very important for the product success, the term X implies that there is an area that the design is focused. The simplest way to implement this approach is to follow a series of guidelines in applying the knowledge acquired. This knowledge is used in order to provide the customer with an improved product. In a number of Design for X methodologies the initial step of introducing guidelines evolved and new computer software become available at the designers level (Brala, 1998; Corrado, 2001).

2. DESIGN FOR X METHODOLOGIES

In the past, a number of researchers dealt with Design for X and this methodology has emerged to encompass a wide range of approaches to product design. A literature survey proves the large variety of methodologies that are available and leading the product and system design to a higher quality.

Kerbrat et al. proposed a new design for a manufacturing system, in order to give quantitative information during the product design stage, during which modules can benefit in being machined and are implemented by an additive process (selective sintering or laser deposition). The methodology was implemented using a computer aided design system. Testing was carried out on industrial products from the automotive industry (Kerbrat et al., 2011). Ferrer et al. considered hot closed die forging and powder metallurgy in order to propose a method for identifying and formalizing the relevant manufacturing information, that the designer should have available for design for manufacture (DfM). The method was based on the Axiomatic Design theory and the designer is able to capture the relationship between design and manufacturing information, in order to obtain the design parameters that achieve product functionalities (Ferrer et al., 2010). Chen and Liu deal with the review and characterization of the conventional molding product development process with an emphasis on the identification of the cost factors. Based on these results, a cost model is developed, which depicts the relationships between cost factors and product development activities, as well as their relationships with product geometry. The proposed model follows the design for cost process according to the product life cycle activities and their cost (Chen & Liu, 1999).

Bras and McIntosh present an overview of the design for remanufacture principles. The review was indented to provide an overview of the types of work that exist in the field and to provide a useful starting point for researchers interested in exploring the area or remanufacturing in greater depth (Bras & McIntosh, 1999). Shu and Flowers refer that the most essential aspect of design for remanufacture was found to conflict with other design for X methodologies (i.e. design for assembly and design for recycling). Design for remanufacture was therefore viewed in the context of other life-cycle domains, specifically manufacture and assembly, maintenance and scrap-material recycling (Shu & Flowers, 1999).

Gironimo et al. proposed an approach based on the quality evaluation of virtual prototypes of new industrial products, by adopting a statistical procedure previously applied to service industries. The proposed methodology was fully exploited through two case studies from different industries (Gironimo et al., 2006). Elgueder et al. addresses the domain of product's industrialization that aims at selecting the manufacturing processes. This selection must be done as soon as possible and has to be strongly linked with product definition and computer aided design modeling (Elgueder et al., 2010). Ferrao and Amaral present a novel design for recycling, (DfR) strategies that were incorporated in a new software tool, combining the use of emerging technologies dedicated to automobile shredder residue recycling together with design for dismantling strategies. The proposed approach includes as an end of life processing strategy, postshredding sorting of materials and subsequent recycling. It describes a new tool that provides the identification of economically optimum recycling strategies aimed at achieving given recycling and reuse rates by combining dismantling, shredding and postshredding activities (Ferrao & Amaral, 2006). Garbie addressed the problem of how the concepts of globalization are guiding the manufacturing enterprise analysts and designers with the most effective issues for analyzing reconfigurable levels. These issues include international issues, contemporary issues, global manufacturing systems, local performance and flexible management. A conceptual framework for a design for reconfiguration was presented and the results showed that the design for manufacturing enterprises reconfiguration (DFMER) should be seriously taken into consideration (Garbie, 2013).

A development strategy driven by user-oriented total design management approach, together with a commitment to the principles of design for manufacturing, has bottom-line implications for today's manufacturers. This is design for marketability, where the physical, social and emotional needs of the user are solved by multidisciplinary teams which develop highly reliable and emotionally engaging products which can be brought to consumers in the most cost-efficient and timely manner. Gianfranco presents a guide to building such a team and finding a design partner (Gianfranco, 1994).

Product flexibility can be defined as the degree of responsiveness (adaptability) for any future change in a product design. Kasarda et al. discussed the concepts associated with a methodology called design for adaptation (DFAD), for achieving advanced sustainable designs. The DFAD methodology is based on the hypothesis that product life ends because a product is unable to adapt to change. It uses the classical control theory and products are conceptualized and modeled as dynamic systems with feedback control strategies, to respond or adapt effectively to changes in performance criteria (Kasarda et al., 2007). Palani Rajan et al. presented an alternative understanding of product flexibility from a design perspective. Using en empirical study foundation, the main objectives of the research was to develop a method to evaluate flexibility of product design and derive a set of guidelines to guide product architecture to a desire state of flexibility (Palani Rajan et al., 2003).

Devadasan et al. provided a modified orthogonal array-based model, enabling researchers to exploit design for experiments in the agile manufacturing environment, in order to achieve design for quality. The characteristics of Taguchi's off-line models and agile manufacturing were studied and a new theoretical model was designed. The model was subject to implementation study in the pump manufacturing industry (Devadasan et al., 2005). Boy and Schmitt presented an analytical approach to design for safety, that was based on 30 years of experience in the field of human-centered design. There are many factors that contribute to design for safety. Among these factors, complexity, flexibility, stability, redundancy, support, training, experience and testing were analyzed (Boy and Schmitt, 2013). Minehane et al. reviewed some of the reliability simulation tools which are available in industry. The capability of the most popular of these tools was described for a number of different reliability hazards. A topical reliability simulation issue was addressed and a statistical validation, comparing measured and simulated degraded ring oscillator data was presented (Minehane et al., 2000)

The present paper is dealing with the area of modern packaging design. This area is traditionally treated in a similar manner with the product design. Although this is not mistaken to some extent, there is a gap for creating a novel design methodology exclusively for the packaging industry. The proposed Design for Skin and Shape (Df S&S) methodology is stressing the idea that the user of a product should understand clearly, which product is held in the proposed packaging by the packaging design itself. The methodology can help towards introducing innovative packaging in people's everyday life. This can be extremely important factor for promoting products, considering that the life style evolves and stresses the artistic part in a number of packaging designs. This artistic point of view offers a great opportunity for increased sales and trend creation.

3. DESIGN FOR SKIN & SHAPE (Df S&S)

The fruit juice industry has seen a tremendous growth of new products in the recent years. The number of juices and juice drink introductions is continuously rising. Many of them include light versions of juices with lower calories and carbohydrate content, or an increase in the variety of juices that are being used together. More exotic flavours (mango, passion fruit etc) have become common in juice blends. New fruits are currently entering the market as healthy, nutritious complements or alternative to snacks. Fortification with vitamins and minerals is also being used to attract consumers with specific health concerns. Juices and juice drinks in this product line are aimed at children, women and older adults.

Manufacturers have also focused on using health-oriented product or brand names to promote health benefits associated with juice drinks. There are also some juice-based drinks that come as alternatives to alcoholic beverages. Packaging innovation in the juice sector continued to focus on convenience and portability (re-sealable, easy-to-shake, easy-to-grip, easy-to-drink etc).

Based on the necessity for innovative packaging, a number of concepts for the fruit juices industry were developed. The prime aim was the increased aesthetic and the attractiveness of the aforementioned products, when presented to the consumer. The key idea behind, was that every packaging must be inspired by the product inside, which means that the content inside must be its key issue. The outcome must be based on the direct join of the outside part (package) of the product, with the content inside (product itself). The innovation is based on their shape and appearance (Design for Skin & Shape). When the customer comes across the proposed packaging, is not puzzled about what it might be inside. In addition to the above, the appearance itself makes the customer more willing to try it and as a result the product has remarkable higher chances of being purchased.

A series of packaging designs is used in order to apply the proposed methodology. The concepts are based on the shape and appearance of a series of fruits and as a result, every proposal is easily recognised and highly appealing to the customer. The presented designs have attracted a great deal of interest from enterprises dealing with juice commerce (Apostolou et al., 2009).

3.1. The Quarter Fruit concept

The first concept is focused on the design of a bottle with the form of a quarter fruit portion (1/4). The four bottles together compose the entire fruit. All the morphological characteristics of the fruit are included to the exterior appearance of the bottle.

The idea constitutes an innovation pack, which promotes the desire for freshness, from the customer's point of view, when buying fruits. Not only gives a promotion advantage through its appearance, but prompts for the purchase of four bottles at the same time (Figure 1).

3.2. The Cut Fruit concept

The second concept follows the previous one and proposes four cut sections to be made in order the bottles to form a square-like shape. This approach promotes the initial idea of the fruit appearance, but at the same time helps its logistics side.

Fig.1. The Quarter Fruit concept for packaging design

Fig. 2. Seven variants of the Cut Fruit concept for packaging design

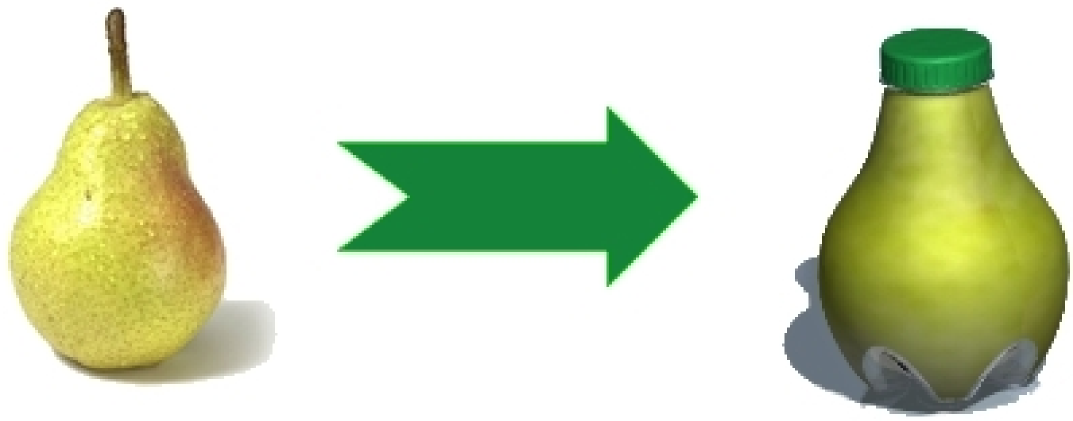

Fig.3. The proposed complete pear conceptual packaging design

It can be used more easily in existing production lines for refill (need for minimum changes necessary) and at the same time smaller gaps appear, when transported with standardised means (Figure 2). The design goal is again achieved with the use of the appropriate label according to the promoted fruit.

3.3. The complete pear concept

The final proposal is based on the geometry of complex-shaped fruits. A representative example that falls in that category is the pear juice. The fruit itself gives to the designer the solution to the problem of finding a simple but easily recognized form (Figure 3). The idea behind is to use a relatively easy to manufacture bottle, together with a colorful plastic sleeve in order the packaging to look like a pear.

4. CONCLUSION

Product designers are using design for X methodologies in order to provide an improved outcome. Although all aspects of the design process are necessary to be considered when designing a new product, in a number of cases it becomes crucial to pay special attention to one or sometimes few of them. This approach offers the possibility to optimize a design from a specific point of view, which is considered to be of the greatest interest. A number of those methodologies were presented. All of them were dealing with product design and it became clear that there is a need for a new tool related exclusively to the packaging design.

Traditionally, the packaging design applications are treated in the same way with the products themselves. The proposed methodology Design for Skin & Shape (Df S&S) is filling the gap in the design process at stresses the differences between product and packaging development. The idea behind is that the customer should be able to relate and directly recognize the product held inside its package. When a potential customer looks towards similar products, he/she should be able to select the one that appears to be more attractive. At the same time the concept should be innovative and able to support the product sales.

In the present paper a series of packaging designs were presented and the Df S&S methodology was successfully introduced. All the proposed designs could promote fruit juices to a different level and create a special relation between the customers and the product itself.

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