Sustainable Manufacturing: A Framework of Cultural Aspects for Sustainable Product Design

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Abstract: Nowadays, product design does not only consider the “wants and needs” of users, but also how the design can be created by embedding sustainability aspects in the product. Culture is also one of the important aspects which need to be considered in product design as culture affects the way users respond to the product. This paper aims to develop a new framework for design development, in which the aspects of culture are incorporated into sustainable product design. By reviewing the existing literature, the authors attempt to identify the gaps of the existing papers, which illustrate how culture affects sustainable product design. Recent papers have only shown that culture influences product design, but they do not explore sustainability and the cultural aspects in product design. Due to these gaps, it is therefore important to create a framework which will assist designers to elicit sustainable product design based on cultural aspects. In summary, designers need to reflect on the “wants and needs” of users. The framework presented in this paper can be integrated into designers’ and companies’ decision-making during product design development.

Keywords: Framework, Culture, Sustainable, Product design, Product Development.

1 INTRODUCTION

In history, product design is believed to be a process of creating diverse features, superior performance, functions and so forth (Noble & Kumar, 2008). In addition, products are one of the most important factors in manufacturing, which require careful consideration from human aspects (Jordan, 1998). Human aspects are affected by their indigenous habits within their region whereas indigenous habits are affected by human culture to the present day. However, culture itself is a broad aspect which influences an individual’s daily life. As it is, each country has a different culture and unique tradition, which form the specialty of the country. The native people’s specific perspective in daily activities is evolving the culture of that nation. This paper is aimed to develop a new framework for designers to incorporate culture aspects in sustainable product design, beginning with the initial stage of the product design process.

1.1 Sustainable Product Design and Cultural Aspects

To date, there are various definitions for sustainable product design. According to (Charter, 1998; Hanssen, 1999), sustainable product design is focused on eco-design products; i.e. products which are environmental-friendly with less negative impact on the environment. However, the following authors, (Gagnon et al., 2009; Howarth & Hadfield, 2006), argued that sustainable product design can be assessed by classifying three aspects: social, economic, environment. These three aspects are strongly related to sustainable development, which can be used by designers to create sustainable product design. The designers require a detailed analysis, which considers the risks and benefits of each aspect pertaining to sustainability (Howarth & Hadfield, 2006). Additionally, cultural aspects are also intrinsically important for product design. Culture is not a generally received opinion, and there are many ways to label the meaning of culture. The definition of culture has been translated to be principally reliant on its aim as a decisive condition (Kluckhohn & Strodtbeck, 1961). However, culture can be described
as a social interaction; it means how the society can arrange their habits (Hofstede et al., 2002). This definition is different than that given by (Taras et al., 2009), whereby culture possesses four characteristics. Firstly, culture is termed as a multi-dimensional character. Secondly, culture is formed between groups of society. Thirdly, a long period is required to create a culture in society. Finally, since culture is shaped by time, a long period is required to change culture. In addition, (Kroebel & Kluckhohn, 1952) classify culture as having more than one aspect which can be determined as a pattern, the behaviour achieved and translated by symbol. They believed that culture is the product of actions from the behavior achievement of human groups.

Several researchers agree with Hofstede’s arguments regarding cultural aspects such as individualism, masculinity, power distance, and uncertainty avoidance. (Cleveland & Laroche, 2007; Taras et al., 2009) assessed their studies to incorporate cultural aspects in their research. (G. J. Hofstede et al., 2002) carried out a study in 40 countries and produced four significant cultural aspects: individualism, masculinity, power distance, uncertainty avoidance.

1.1.1. Power distance

Power distance is "the extent to which less powerful members of organizations and institutions (like family) accept and expect that power is distributed unequally" (G. Hofstede & Bond, 1984). This definition shows that customer preferences can influence product design. Power distance can be translated as manufacturers, designers, industries and so forth, who have ability to create new product designs based on consumers’ requirements.

1.1.2. Individualism

Individualism refers to the "relationship between the individual and the collectivity which prevails in a given society" (G. H. Hofstede, 1984). Individualism in product design can be delineated as the preferences and interest of the consumers for designers to create new product designs (Marti & Bannon, 2009). This statement is supported by Hofstede’s argument that everyone has their own interests in deciding their preferences (G. Hofstede & Bond, 1984).

1.1.3. Masculinity

Masculinity is identified as the level to which culture is illustrated by power (masculinity) (G. Hofstede & Bond, 1984). High degrees of masculinity show that the character is more focused towards its purpose, performance, task and achievement (G. H. Hofstede, 1984). These statement shows that the characteristics of products can be affected by respective cultures.

1.1.4. Uncertainty avoidance

Uncertainty avoidance is a cultural aspect dealing with people’s tolerance on unpredictable, unclear and unstructured situations (G. Hofstede, 1984; Nakata & Sivakumar, 1996). This statement indicates that designers need to forecast consumers’ preferences and ways to determine that the consumers’ requirements are intangible. Designers should be aware of consumers’ requirements and the selection of products by consumers. Hofstede emphasizes that culture is an important aspect, which needs to be determined clearly. For this reason, a culture with strong uncertainty avoidance is aggressive, emotional, security-seeking and intolerant. On the other hand, a culture with weak uncertainty avoidance is less aggressive, relatively tolerant, and contemplative. Hofstede’s arguments can be translated into product design as the consumer’s characteristics with regards to consumers’ preferences.

1.2. Reasons why cultural aspects need to be considered in product design process

Culture can control all aspects in every site of human life (G. H. Hofstede, 2003). When designers begin their design, they need to determine what are the consumers’ requirements for their designs (Noble & Kumar, 2008). Considering the consumers’ “wants and needs” is very important in product design process as this affects the criteria of the product. The product criteria are based on various requirements of the targeted market such as shape, colour, materials, quality, duration, usage, price and so forth. The selection of a product’s criteria is made by the perspective of the consumer as they are the users of the designed product (Marti & Bannon, 2009).

Although designers have to consider the consumers’ “needs and wants”, they also need to consider their capabilities to design the product. Occasionally, it is difficult for designers to determine the consumers’ needs as their cultures are intangible to measure and easy to change (Moalosi et al., 2010). Nonetheless, culture can significantly influence product design development (Press & Cooper, 2003). However, culture does not only pertain to consumers; it also pertains to designers, as designers’ preferences are shaped by their cultural and social values (M. Razzaghi & Ramirez Jr, 2005). Hence, it is evident that culture cannot be separated in sustainable product design development.
1.3. The influence of culture on sustainable product design

The relationship between culture and design has many obstacles until the last decade and it is going to be a challenge for designers to create high-quality designs, as well as user-friendly and environmentally-friendly products. Product value can affect people’s attitude in social activity. The product selected by a consumer reflects culture. It is significant to design appropriate features, which incorporate cultural aspects (Moalosi, Popovic, & Hickling-Hudson, 2010).

Designers must be open-minded with consumers’ requirements and develop product specifications with prioritized focus on the consumers. This means that the designers should identify the cultural background of user. The product is likely to be wasted if the product does not represent the user’s needs (Marti & Bannon, 2009).

1.4. Incorporation of culture in sustainable product design

When a product is going to be designed, there are many aspects which need to be considered by the designer. The concept of the product will be developed according to the consumer’s needs and requirements. In order to produce good product design, the designer should not solely focus on the consumer’s personal needs and requirements. Rather, the designer should incorporate cultural aspects into the product design. The designer should possess a solid understanding on the indigenous user’s culture in order to achieve this purpose (Popovic, 2002).

Until the present day, the identities of culture cannot be found clearly, which is caused by increasing global market competition, particularly for products. (Mohammad Razzaghi et al., 2009) stated that industrial product concepts are partially made based on the designers’ culture. In their research, they assessed the influence of Australian and Iranian industrial designers’ culture on product design. The results revealed that there were links between cultural archetypal and the designers’ own culture on the product’s pattern and appearance. The same authors conducted another research with same theme, and they found a relationship between culture, designer, user and product. They recommended that the significances of culture should be assessed through product design development.

According to (Tonny C.Garret et al., 2006), the Western culture may not be adopted in other nations due to the fact that each culture is different from each other. They used qualitative and quantitative methods to determine the domain culture and their results showed a significant dissimilarity between the two methods. This indicates that there is a chain between formalization, centralization, role flexibility and inter-functional climate mechanisms with the Hofstede’s dimension of power distance.

2. PURPOSE OF THE FRAMEWORK

In order to obtain reliable results in this research, the authors attempt a systemic-thinking framework for sustainable product design influenced by culture. The input of this system is divided into 4 (four) stages:
2.1.1. Description of Stage 1
The inputs for the product design framework are described in this section. The inputs can be classified as cultural aspects, sustainable concept, and product design. Cultural aspect is divided into 4 (four) factors: Individualism, Masculinity, Power distance, Uncertainty avoidance (Cleveland & Laroche, 2007; Taras, et al., 2009). Firstly, Individualism refers to the “relationship between the individual and the collectivity which prevails in a given society” (G. H. Hofstede, 1984). In this framework, Individualism can be characterized as the preferences and interests of the consumers, designers, and manufacturers in developing new product designs. This is supported by Hofstede’s statement that each individual has his/her own interests and preferences (G. Hofstede & Bond, 1984). Secondly, Masculinity refers to gender influence. The opposite of masculinity is feminism. The designer needs to consider the product gender and target of the product, and ask the question “For whom the product will be created?” Gender specifications influence product preferences (Worth et al., 1992). Thirdly, Power Distance can be explained as the people or organization included within the product design process. Each person and organization has a desire in deciding their requirements. For instance, the designer determines the product concept, the users decide what they want or do not want to buy, whereas the manufacturer may decide to produce products with middle and high-scale production. Finally, Uncertainty Avoidance is identified as how designers predict the unclear, unpredictable, and unstructured. Uncertainty Avoidance is affected by increasing unpredictability of the future. However, the designer needs to know the new information, style, and characteristics of the product.

2.1.2 Description of Stage 2
In this framework, the sustainable concept is divided into three (3) important aspects: social, economic, and environment. Firstly, in the context of sustainable product design, the social aspect can be translated as the behavioral, attitude, and beliefs of the designer, consumer, and companies (Moalosi, et al., 2010). Their social behavior, attitude, and beliefs influence the characteristics of products such as shape, color, function, and so forth.

Secondly, from the economic viewpoint, there are several factors which need to be considered in sustainable product design: price, market analysis, population growth which influences the production
size. The whole production cost determines the price of the product. Although highest profit is the main target of companies, companies should also know the capabilities of the consumers, i.e. Who will buy the products? It is for this reason companies and designers constantly engage themselves in analyzing the market during the product design stage.

Thirdly, environmental issues are also of utmost importance in sustainable product design concept. The designers, companies and consumers should actively maintain a clean environment. Additionally, designers and companies should gain adequate understanding on the whole product life cycle, beginning from raw materials until the waste product, after the product has been used by the consumers. Therefore, in order to elicit eco-design for sustainable product design, designers should emphasize good waste management and practice the 3R concept: Reduce, Reuse, and Recycle.

2.1.2. Description of Stage 3

We are often faced with the following questions: “Why design is required for products? What is the purpose of design? When do we need product design?” The answers of these questions can be known after designers have acquired information on the consumers’ “needs and wants”. Translating the consumers’ “needs and want” is not an easy task as the “needs and wants” are intangible to calculate. Generally, designers should know the characteristics of the product based upon the consumers’ requirements. Additionally, designers should also be aware of their design capabilities as the technical requirement. Technical requirement is obtained based on the consumer’s requirement. Product design characteristics involve fashion or style, utility, ergonomic aspects, and other elements which can support product creation (Noble & Kumar, 2008).

2.1.3. Description of Stage 4

This stage involves calculating consumer’s satisfaction. The analysis may involve qualitative and quantitative methods. Interviews will be carried out for qualitative methods, whereas quantitative methods will be used for data calculation. Quantitative method is used to obtain information regarding consumer’s satisfaction using questionnaires. Generally, not all consumers are satisfied with the product which has been created. This case can be the designer’s groundwork to synthesize why the product is unsatisfactory. Unsatisfactory products will be a major “waste” for companies. It is for this reason designer and companies need to “Rethink” to rectify the problem and propose a new methodology, design and so on. A summary of Stage 1 to 4 is shown in Table 1.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Aspects</th>
<th>Relevant issues</th>
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<tbody>
<tr>
<td>Culture</td>
<td>Individualism</td>
<td>One’s own preferences</td>
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<td></td>
<td>Masculinity</td>
<td>Gender-specific</td>
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<td></td>
<td>Power Distance</td>
<td>Capabilities, preference of stakeholders</td>
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<td></td>
<td>Uncertainty Avoidance</td>
<td>Prediction of the future (increasing Globalization)</td>
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<tr>
<td>Sustainable Concept</td>
<td>Social</td>
<td>Behaviour, attitude, beliefs</td>
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<td></td>
<td>Economic</td>
<td>Target of market, cost production</td>
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<td></td>
<td>Environment</td>
<td>Less emission, Eco-Design, environment-friendly</td>
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<td></td>
<td>Technology</td>
<td>Use current technology to develop product design concept</td>
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<tr>
<td>Product design</td>
<td>User/Consumer</td>
<td>Critical analysis of consumer’s satisfaction and requirements</td>
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</tbody>
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3. DISCUSSION

After reviewing articles pertaining to cultural aspects in association with sustainable product design, a new framework is proposed, which focuses on consumers’ requirements and preferences. The consumers’ requirements and preferences can be determined by designers by referring to cultural aspects. (Moalosi, et al., 2010; Nakata & Sivakumar, 1996; Mohammad Razzaghi, et al., 2009) also suggested similarity concepts as that presented in this paper. However, they have shown only cultural aspects in product design and they did not show explicitly the sustainable aspects. In order to obtain a clear picture of the influence of cultural aspects on sustainable product design, it is proposed that and a model and tool which incorporate cultural aspects in sustainable product design are developed.

CONCLUSIONS

Cultural aspects in product design are very important because each country has a different culture which can affect in sustainable product design development. In addition, to create sustainable product design, it is not sufficient to have an understanding on the cultural aspects. The process of product design and sustainable concepts should also be considered. Hence, designers and companies should collaborate to achieve good designs which are consumer-oriented as well as analyzing the market and learning to develop eco-design products. However, cultural aspects and sustainable product design have to be determined because cultural aspects can reinforce sustainable product design process and development.

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