A REVIEW: A MODEL of CULTURAL ASPECTS for SUSTAINABLE PRODUCT DESIGN

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ABSTRACT

Product design stages are important to consider critically in production. Generally, product design that shall be created by designer, should consider what the customer wants and needs. Nowadays issues, product design does not only consider the "wants and needs" of user, 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 model 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 culture aspects in product design. Due to these gaps, it is therefore important to create a model 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: Model, Culture, Sustainable, Product design, Product Development.

I. INTRODUCTION

Previously, product design is believed to be a process of creating diverse features, superior performance, functions and so forth (Noble & Kumar, 2008). additionally, 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 model for designers to incorporate culture aspects in sustainable product design, beginning with the initial stage of the product design process.

A. The Principle of cultural definitions

Culture is not commonly received opinion, and there are many ways to define the meaning of culture (Davis et al., 2008; Mohammad Razzaghi et al., 2009; Tonny et al., 2006).

When the people try to gain the meaning of culture, it will be so broad and cannot be determined obviously even from the scholar researchers who want to know the definition of culture. For example, there are various researchers who have been conducted and be a central focus understanding of cultural definition. Culture can be defined as social relations; it means how the civilisation may arrange their habitually (Hofstede et al., 2002). Different with (Taras et al., 2009), they defined the culture to be three definitions. First, culture is defined as a multidimensional character. Second, culture is formed between groups of society. Third, need a longer period to create a culture in society. Finally, culture is shaped over a moderately long period and in the end, culture is stagnant.

Culture is a side street meaning and widespread definitions. (Kroeber & Kluckhohn, 1952) pointed out, the culture has more than one aspect that can be determined as a pattern, behaviour achieved and translated by symbol. They argued that culture is product actions from the behaviour achievement of human groups. Cited in (Brumann, 1999) that culture is the entire compound of ordinary behaviour that has been created by the human race globalisation and is developed base on each concern. Similarly, they argued that culture is a tool to learn for new knowledge. It is connected through the groups of individuals as well as its content embraces a broad choice of and norms shared meaning, valued and patterned of product behaviour. However, defining culture when of globalisation influences shall develop continuously. The concrete definition of culture cannot be defined plainly. All in all, culture is one which has made by long-time period of individual or groups that involve of behaviour, norms, attitude, and rule.

The definitions of culture have been introduced briefly in the previous section. There are several definitions used for cultural meaning. However, within the cultural understanding, there are some aspects of culture that can infer the specific understanding of culture (Birukou et al., 2009). As explained definition of culture, large issue for many literatures, they explained the significant of behaviour for the individual or group in society. The culture is implied for behaviour however culture is a tool for the social to learn and improve their understanding simultaneously increases with the time and globalisation (Moalosi et al., 2010). To know the culture increasing that is one matter for the scholarly researcher who wants to stand the clear understanding of cultural meaning. To reinforce the meaning of cultural understanding can be known from the aspects of culture itself (Hofstede, et al., 2002). There are many researchers explained in labelling the cultural aspects which have been using the culture aspects by citing the Hofstede culture aspects. Cultural aspects are not only determined by Hofstede aspects, it can be cited by shaping of the cultural meaning based on the experience and survey of the real condition.

The specialist cultural anthropologist, Hofstede, is one of the pioneers of cultural anthropologist who found the culture aspects understanding. He has been an expert in developing of national culture differentiation assessment. In his article (G. Hofstede, 1984) he explained that culture consists of 5 (five) aspects:

1. Individualism and collectivism
2. Masculinity and femininity
3. Power distance
4. Long and short term oriented
5. Uncertainty avoidance

The cultural aspects that have been defined by Hofstede are used by other researchers to explore their research, For instance (Moon, et al., 2008; Nakata & Sivakumar, 1996). However, occasionally, they just used some of the cultural aspects that have properly meaning of their research. It inferred the cultural aspects that offered by Hofstede is proper in this paper.

B. What is product design?

Before the researcher explains more detail about sustainable product design, the exploration of product design understanding is needed. In general, product design circle stages

are consists of pre – manufacturing, manufacturing, transportation/ distribution, consumer market (user), and disposal stages (Alting, 1995). The creation of products is started by designing stages (Geoffrey, 1994). By the designer feeling, design stages of a new product are more complicated than the next stages. Therefore, various gear that should be retraced by designer to gain a better product. For example, deciding the customer requirement, measuring the technical requirement, analysing time optimisation and so forth before carrying on to manufacturing stages to be produced (Green et al., 1981)

Figure 1. life cycle of product (Alting, 1995)

High quality of product design can attract the customer preferences to the product (Bloch, 1995). To gain successful product, considering the customer requirement and technical requirement should be determined concurrently. It means that what the customer wants in the product is what the designer will do to create a better product design. On the whole, the product design is reinforced by the customer requirement to grasp the market need analysis. The target of the manufacturing is to gain the highest profit however less production cost. From the customers need analysis, the designer can analyse the product. The way to analyse the product can be mirrored by marketplace whether the product is accepted or rejected in the market. However, Green et al labeled that successful product can be defined to be four criteria.

First, the designer should consider the market target, analysing by clustering the market to gain customer requirement in cluttered markets and translate it within the form of product design (Berkowitz, 1987; Jones, 1991). For instance, successful market has been achieved by Yoplait Yogurt. This manufacturing creates the design of container that has a different appearance and form rather than the other yogurt container. Similar to Swatch Company who creates a watch design using different style to however reinforce with customer needs analysis (Hollins & Pugh, 1990).

Second, considering the importance of surface product appearance is needed to communicate the product value to the customers (Nussbaum & Port, 1988). Product specification principally in quality appearance can create the feeling of the customer (Berkowitz, 1987). Third, managerial level in the product design form should be considered the sense of product which can influence the life of quality for the user because of the impact of product design on customer daily live is influenced by-product. Feeling or view of the product design emerges when the product appearance of the product can make sense to the user otherwise the product become unattractive to the customer (Lawson & Lawson, 1980). Last, product design also can affect the sense of customer for long-time. Although, some of the product has a short lifetime, the appearance characteristics have impacted many years for the user whether bad or good appearance (Pye, 1978)

C. Sustainable product design

Moving towards to be worldwide sustainable will engage sinking energy and source. Similarly, the production of pollution and waste in which to produce waste from industries is not be able to stop for a whole day (Reijnders, 1998; Weiszäcker et al., 1997) The apprehension of environmental damage on the Earth has become a hot issue in the recent day. The constraint of resources of the time is decreasing because of uncontrollable of human needs. In addition, impact of environmental for human become alarming to all aspects of daily life of human even for product design. There are several issues that should be determined in product design stages to create a sustainable product design. The 3 main ideas that should be considered in product design for sustainable product are social, economic and environment. How to translate the sustainable concepts for product design becomes focus in this section.

For social, many populations in the world are growing up day by day. 50 years after the current day populating human will increase rich until 9 billion, for example China population, before 2 previous decade increase 70% compare with the nowadays (Howarth & Hadfield, 2006). It showed the increasing of population will affect the needed of product while the various insights will appear to the customer as the user in the population. In addition, Product design itself is created by identifying of customer preferences of the market analysis. Ensuring the precise preferences of the market is depending on the customer needs characteristics. As it is, the needs and wants of the customer are affected by behaviour and emotions. Social environment plays active within the behaviour of individual customers. Fundamentally, the social environment intangible to measure because this aspect shows the characteristic of behaviour which need analyse based on the real condition. The divergence of behaviour of customer is predicted as unique behaviour while it is difficult to assess. To develop sustainable for social in product design, there are 3 main factors that should be considered e.g. Analyse the customer behaviour using qualitative methods, use questionnaire to grab the behaviour reasons, and analyse the by comparing studies.

For economic views, product design development is centred in marketing analysis. As the designers, to gain a sustainable product design, analysis the customer preferences are important. For example, price of the product. In several cases, customers more consider about the price than quality despite the product has a good quality yet the price is not proper for the customer, the product will be difficult to accept for the customer (Veale & Quester, 2009). Two situations condition that can complicate to designer, in one hand, they should consider analyse the needs and wants of consumer to get good specification product (Petiot & Yannou, 2004). On the other hand, by manufacturing, they should work quickly because of the market competitions by another at the same time also improve their product market as well. Substantially, product design has been considered based on the market analysis however designers as the ability in product design should open their insight to predict for the next market target.

For environmental aspects, nowadays, the issue of environmental for sustainability is rising. In product design views, the designers should not only consider the form of the product, the market analysis of customer, but also should critically open their insight of product after used while the life cycle of a product should be determined properly e.g. pre-manufacturing, manufacturing, distribution, use, disposal (Alting, 1995).

D. 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, (Kroeber & 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. (Hofstede, et al., 2002) carried out a study in 40 countries and produced four significant cultural aspects: individualism, masculinity, power distance, uncertainty avoidance.

1. Individualism and collectivism

    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).

2. Masculinity and femininity

    Masculinity and femininity are one of aspects of culture. This term can be translated as the gender specific that can show the human characters. (Hofstede, 1980) pointed out that masculinity is the level to which social values, ferociousness, and asset achievements whereas cultures Femininity in within cultural understanding is connection value of societies, harmony, and modesty (Mohammad Razzaghi, et al., 2009). This theoretical implied to product design that masculinity and femininity aspect is more focus on the character of the customer. Customer character is influenced by their gender. Customer with high masculinity is more interested in the usefulness of the product e.g. Quality, durability, reliability and so forth. While, the femininity is more focused in appearance of product e.g. style, luxuries appearance, good shape, and so forth. The designer can consider these aspects as the reasons to know the interests of the customer. Sometime as a man, there are many customers having high femininity and a woman has high masculinity. However the character of human is not easy to fix in product design. The designer should know what the customer needs in their product specifications.

3. 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.

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.

E. 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, 2001). 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.

F. 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).

G. 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, this 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.
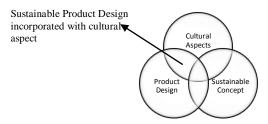

Figure 2. Incorporation of culture in sustainable product design

According to (Tonny , 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.

II.   PURPOSE OF THE MODEL

In order to obtain reliable results in this research, the authors attempt a systemic-thinking model for sustainable product design influenced by culture. The input of this system is divided into 4 (four) stages:
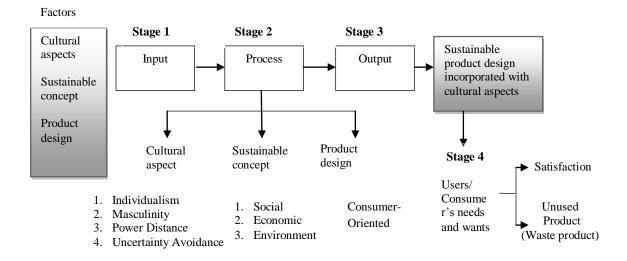

Figure 3. Model of incorporation culture aspects, sustainable concepts for product design

1.   Description of Stage 1

The inputs for the product design model 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 model, 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. Description of Stage 2

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.

3. Description of Stage 3

We are often faced with the In this model, 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 behaviour, 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 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).

4. 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 1. Analysis of cultural aspects, sustainable concept and product design issues

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

III. DISCUSSION

After reviewing articles pertaining to cultural aspects in association with sustainable product design, a new model 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.

IV. 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.

V. ACKNOWLEDGEMENTS

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