Investigating Users' Acceptance in Designing and Marketing Sustainable New Product

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Abstract
Understanding the needs of users and how to fulfill them is imperative in designing and marketing a new product. We limit our study on case study of exploring users' perception and acceptance on a new product using sustainable material from oil palm non-skin particleboard as an alternative medium in furniture manufacturing and design. In this study, we conducted a survey on the acceptance of public users' and experts' perception for the new product. Results indicate mix acceptance levels where majority of the respondents agree that the new product is attractive and could respond to global agenda of more environmental-friendly and sustainable product. This paper contributes towards integrating marketing research with design process in exploring users' acceptance as part of the promotion of sustainable new product.

Keywords: furniture design, market survey, sustainable product design, users' acceptance

Introduction
The search for alternative material to reduce dependency on nonrenewable resources has been part of sustainable development efforts. With increasing developments of newer bio-composites into the furniture industry, it is imperative to investigate the acceptance level of users for this new green product. Sustainable or green product is one strategy to become competitive in current global market. The use of sustainable material was reported to have led to "competitive advantage since it is widely accepted that the bulk of the cost of a product and its production process are committed to the design stage" (Handfield, et al. 1997). Most product designers are aware of the need to produce workable, safe and functional products, and it is important for them to find out whether the product can elicit positive psychological link to users. Product design that promises aesthetic appeal, pleasure and satisfaction can ensure the success of product (Desmet, 2008). Therefore, designers and manufacturers share similar objective, which is to ensure the product can deliver its promise and aesthetically appealing to users. To test whether a new product is marketable or if the product can be successful, user's acceptance is important. As a preliminary study on users' acceptance of a new product, this paper explores users' and designers' views and acceptance on new benches made from sustainable material, which is oil palm non-skin particleboard. It is to gauge the level of acceptance and to understand their needs and requirement especially on new product using sustainable material.

The Design Process
Designers from all ages agreed that the whole process of producing of a product should create a distinctive character or product personality to create high product affection. Therefore, exploration of users' acceptance on furniture using oil palm biomass is necessary to convince furniture industry to venture into this new material. A product must have functional appropriateness as well as usability. The field of usability has traditionally focused on ease of use and functionality based on measurable, observable cognitive activity. Globalization and advance progress in human cognitive levels indeed has created a new wave of consumers. Designers, on the other hand, must keep pace with current changes in consumer taste and preference. Tapping the user's emotional interaction with products could lead to more informed decision-making in the designing process (Desmet, 2008; McDonagh, et al, 2002). Traditionally, the process of product design and user acceptance at one instance is likened to Maslow's hierarchy of needs (Ashby and Johnson, 2003). Against the popular basic needs listed by the theory of needs, Ashby and Johnson (2003) assert that at the very basic level of 'need', functionality is important in which the product works, safe and functional. The second level deals with usability while the highest level focuses on satisfaction where user's affection for the product is highly stressed (ibid.).

To satisfy these needs, interactive process between designers and users is highly recommended. At this level, emotion and 'pleasure engineering' plays important role in product design. Furthermore, pleasurable products are being seen as a key contributor to the competitive advantage of a firm, which in other words, gain users' acceptance. Materials play an important role in the experiences people have with product, therefore, selection of material should consider the needs of target users (Kesteren, 2008). In this study, when users interact with the new bench, the users' senses are in contact with the product were being explored and recorded. Users see colors of material (new benches), feel texture on the surface of the bench and feel relaxed while sitting on it. These sensory experiences contribute to the experience of the user, in which their responses are used in modification process. Product personality and material are not the only aspects of a product.

There are many more such as costs, shape, environment, use and function (Kesteren, 2008). This study only uses considerations on integration of form, texture and color as well as comfort aspects as guidance in creating better product form, but not by considering them one by one. Many of the aspects interact, which makes designing a balancing act between different aspects. They represent different elements of design and relate these elements, e.g. function, form and use. The study used sustainable material (non-skin particleboard including the existing aluminum bench structure) to give users a desired sensory experience. In addition, the study selected material for the product to elicit the right associations, for example the non-skin particleboard used in a bench expresses status as suitability with the Kuala Lumpur International Airport concept – Airport in a Forest or to portray Malaysia as oil palm is one of the major economic contributors for the nation.

Oil Palm Biomass as Alternative Sustainable Material for Furniture Products

Since Malaysian government's move towards industrialization from agricultural based economy in late 1970's, manufacturing products and oil palm based industry have steadily entered and becomes Malaysia major economic contributors. However, the price of development has to be paid in terms of oil palm industry's waste and residue being dumped into the environment. Efforts have been made to reduce and re use the industry by-products with the objectives of enhancing the economic viability, reducing environmental impact and reducing the pressure on other natural resources such as tropical timber. 1990's has also witnessed the increasing importance of environmental-friendly industrial management and developing green products in furniture industry (Handfield et al, 1997). Global awakening for sustainable development and ISO 1400 certification system in 1996 become a driving force for environmentally-friendly practices, which is not an option, but necessity for survival.

In parallel, Malaysian government stricter regulation on environment combined with corporate/consumer environmental awareness has further necessitate the move for eco-friendly products. Waste reduction and process improvement as well as introducing alternative fuel from palm oil industry have led to many researches such as the use of palm oil biomass for organic fertilizer and fuel (Harimi et al, 2005). Malaysia is reported to be one of the leading oil palm producers (Sumathi et al., 2007) which almost half of the total cultivated land consists of oil palm plantation. From these 3.6 million hectares, the plantation produced over 35 million tones of biomass in the form of trunks, fonds, and empty fruit bunches annually. This accounted for about 94% of the total Malaysian agriculture residue (ibid.). Several studies indicated that although there are research, development and efforts to utilize agriculture residue, the Malaysian furniture industry has not fully exploited the availability of new raw materials and available new technologies (Harimi et al, 2005, Sumathi et al., 2007).

At the same time, demand for timber in manufacturing industry has shown a remarkable increase. This could stress up Malaysian natural forest reserves. With increasing developments of newer bio-composites into the furniture industry, furniture manufacturers should venture into renewable materials to reduce the pressure of nonrenewable local timber. As such, the use of oil palm biomass particleboard in furniture making could support the concept of "cradle to cradle" in product making thus reducing waste. In line with the Tenth Malaysian Plan to pursue sustainable development and problems faced natural forest to meet increasing demand, this paper is to propose alternative material for furniture manufacturer. The Malaysian Oil Palm Board (MPOB) actively promotes oil palm non-skin particleboard for furniture making, which is used in this research in building a prototype bench. Study in acceptance level of consumers for new medium could assist in facilitating more usage of renewable material. This paper presents part of findings gathered from a research on users' acceptance of new benches at Kuala Lumpur International Airport, Malaysia, using oil palm non-skin particleboard.

Market Survey on New Product

Studies on consumer response to new product plays important role in predicting the product's success (Laros and Steenkamp, 2005; McDonagh, et al, 2002).

A study has shown that customers are becoming sophisticated and willing to pay for green products to save the environment and *"environmentally-friendly designs emphasizing recyclability, remanufacturability and refillability are becoming more important than ever"* (Handfield, et al. 1997: 308). The success of a product depends on its ability to attract and respond to user action by visible, acoustic or tactile response. As Pujari et al. (2003) suggest, the essence of effective new product development lies in creating product whose core attributes (which deliver the basic benefits sought by customers) and auxiliary attributes (which help to differentiate between product meet the needs of customers and other internal and external stakeholders). It is remarkable to note that many products fail to do this, and in return, fail to attract their potential users. Although many new products start from innovative and novel ideas, many failed to attract due to lack of sensitivity towards users' needs.In this research, oil palm non-skin particleboard was used as an alternative medium in furniture design, in particular, to replace the padded benches in study site. Exploring users' acceptance on a new product is important to understand the needs and wants of the users and how to meet them.

Methodology

This research was prompted by the growing demand for green and sustainable products. Starting from the search for best medium to replace the costly imported fabric coated benches at Kuala Lumpur International Airport, the researchers proposes a new sustainable medium made from oil palm biomass which is easily accessible. It was found that, after some period, most of the fabric-coated pad benches were stained and torn due to excessive, wrong or rough usage. The research started with the process of designing the new bench using the proposed sustainable medium, which is oil palm non-skin particleboard. The material has been tested on its strength and durability to withstand weight, heavy use and weather. The particleboard from oil palm biomass was designed according to the original frame, manufactured at MPOB lab, then installed to replace the easily torn and soiled fabric-coated pads, on the original bench's metal frame after being designed and made at the lab. The new benches were installed next to existing cushioned material, mainly to compare, as well as to create different ambiance, personality and attractiveness to users. The purpose of this study is to find alternative for the existing padded fabric material to a more long-lasting, durable and local material.

In addition, product emotion was also analysed based on users' perceptions and preferences. To investigate users' acceptance and perception on aesthetic value and comfort of the new bench, several set of new benches were put on site so that comparison can be done. For this purpose, the researcher built 20 units of new benches using non-skin particleboard. Primary data was gathered to seek and understand users' motivation and perception through quantitative and qualitative methods. The new benches were installed in the airport waiting lounge after getting permission from the Malaysian Airport Berhad.

Figure 1: The two set of benches made of different materials were placed side by side for easy comparison. The seating of the bench on the left is made from padded cushion might given the ordinary and typical ambiance for other airports. The right bench is made from non-skin particleboard and might give impression unique to KLIA concept.

In this study, a survey was conducted on 210 respondents from different nationalities purposely to gauge international responses. Respondents for the survey were chosen randomly as they passed through the site where the benches were installed or when they were resting on the benches. In addition, comfort testing on 13 volunteers was also conducted to assess the body comfort when sitting on a new designed bench made from oil-palm particleboard for a specified period of time. The objective is to explore the level acceptance of the new benches or how the bench relates psychologically to users. Besides, observation and experts' perceptions were also conducted to correlate with findings from survey. Respondents were first being briefed of the product and the product concept to clarify their understanding of the new bench. This is based on Lundahl's (2006) statement that emotive research requires holistic research design, therefore, respondents must be presented with complete information about the product concept to elicit accurate expectations. Questions ranged from visual perception, aesthetic and comfort of the alternative benches.

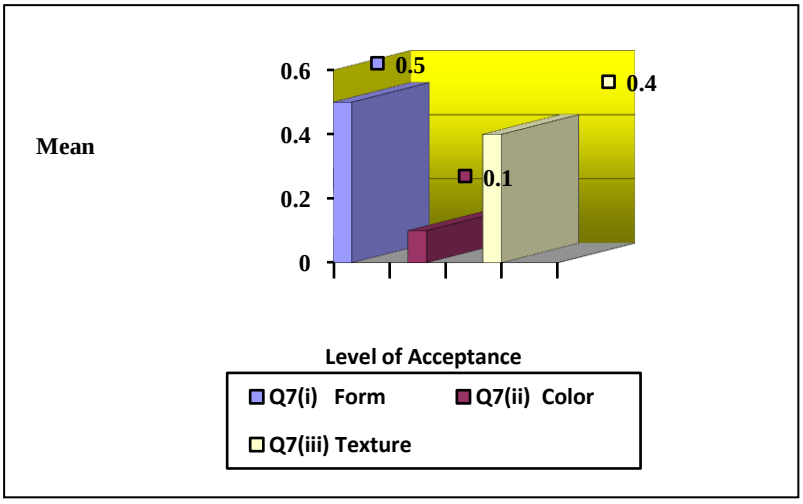
Findings from these methods were tabulated and analysed to assess the users' acceptance of the new benches. This research also includes emotion study which involves an assessment, or appraisal, of how a product may look attractive to a person. This appraisal is a non-intellectual, automatic evaluation of the significance of a stimulus for one's personal well-being. In this research, respondents were required to appraise the new bench to elicit their responses based on the product aesthetic and comfort. The aesthetic measurement is based on colour, texture, and feeling when touching and using the product. Since a respondent may have various attitudes, if a product that corresponds with (one of) respondent's attitudes is appraised as appealing, it will elicit emotions like attraction. A product that conflicts with (one of) our attitudes, is appraised as unappealing and will elicit emotions like disgust. It is worth to note here that one can have a dispositional liking for a product because of previous bad experience.

In this study, a framework for user experience were established where pleasure must satisfy two levels.The first level involves appearance (aesthetics) and user interface (usability). The second level extends to user personality (socio-cultural context), product meaning (time/historic context), environment (physical context), interaction (use context) and product novelty (market context). The objective is mainly on exploring users' acceptance to the new product and their perception on its meaning to portray the Malaysian image at the airport as well as supporting sustainable design. In designing the bench, measurement of sitting comfort or discomfort is one of the greatest challenges in this research. Comfort in this research is measured through case study, using questionnaire and also based on a method adapted from FIRA Ergonomic Unit as it has been proven that this kind of testing could provide valid results (www.fira.co.uk). The results from the comfort study complemented findings from survey, interview and observation. For comfort study, 13 volunteers (from various ages and weights) were willing to participate and spend about 45 minutes of their time to sit on the new benches. The process of asking random respondents to participate in this comfort analysis was not easy since many of the passengers approached were in a hurry.

Findings and Discussion

This section discusses findings and analysis of data. Since product emotion relies on aesthetic value, questions were on how respondents perceived the color of the new benches. It was found that 56.6 % of respondents regard the colour of new benches was somewhat pleasing to view. On the form, 69% of respondents agree that the new bench possessed aesthetic form while 68 % responded that the texture has aesthetic value. The question on aesthetic revealed that the majority of respondents gave positive response and agreed that the new benches possess good aesthetic value. The findings show that the texture of new benches design scores highest with average of 0.5 which means respondents agreed on the form of bench. Majority of respondents agreed that the combination of form between the existing aluminum structure bench combined with replacement of non-skin oil palm particleboard are most suitable with KLIA architecture, which is inspired by the structure of the oil palm tree. Besides, the design concept at KLIA is centered on the harmony of style and substance, critical for a world class airport. It also echoes Malaysia's Vision 2020 focus of balancing high technology with local resources, culture and heritage.

Chart 1: Users' acceptance on the product's form, colour and texture



The result of three elements in aesthetic value (form, color and texture), as shown in Chart 1 above, shows that respondent somewhat agree on the aesthetic of the new bench design. This means that there is a high level of acceptance for this new product despite some minor needs for modification. Results indicate users' high preference on the attractiveness of the natural grains of the biomass medium compared to the existing fabric finish. Majority of the respondents, after realizing the material was from oil palm biomass, agree that the alternative medium matches the existing contextual setting where the medium supports the airport's concept of being an airport in a forest. When respondents were asked to response whether the overall form, colour and texture of the new bench welcome people to sit on it, 74% agree with this statement. However, it is worth to note some negative responses. Some of the reasons given by those who disagree were the bench's texture seems too hard and may not be comfortable for a long period of sitting. This proves that although some elements to create emotion may achieve positive response, there is the need to combine all necessary elements to yield overall good emotion to a product. It also implies that this new product may not achieved maximum satisfaction without taking into considerations the negative responses.

However, according to survey, majority or about 148 or 71% of 207 respondents gave negative responses on the statement that the bench looks and feels comfortable. Those who rated somewhat agree to strongly agree were only 62 or 30%. This shows that majority of respondents perceived the bench as not comfortable and the designer needs to rectify consider this aspect in the process of designing. Based on the comfort study where 13 respondents volunteered to sit on the new benches for 45 minutes, majority of them reported that they were still feeling comfortable sitting even after the period had passed. Only 2 respondents with weight 53 kg and 70 kg felt slight sensation and numbness on their body areas after sitting on the bench. Observation concurred with findings that prove that the seat was comfortable to some people where a number of users were seen sitting on the new benches for more than one hour although they have option to sit on the fabric coated cushioned benches nearby. This study asserts that comfort does not mean that the benches need cushion padding.

Chart 2: Level of Comfort of the New Bench

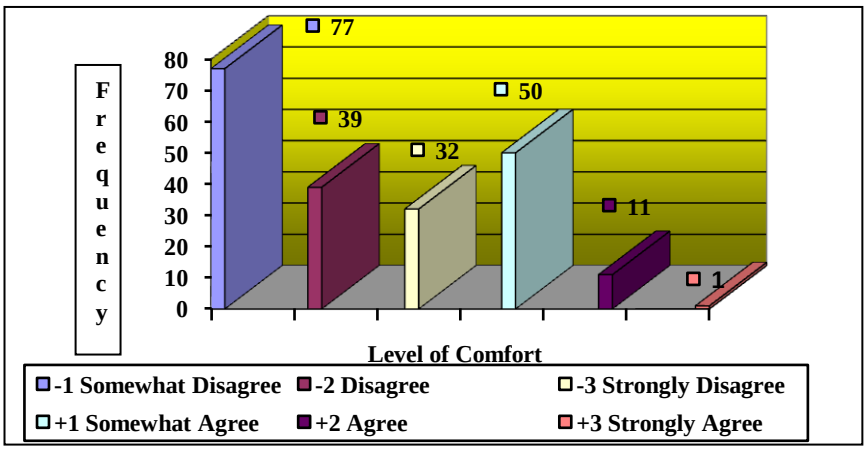
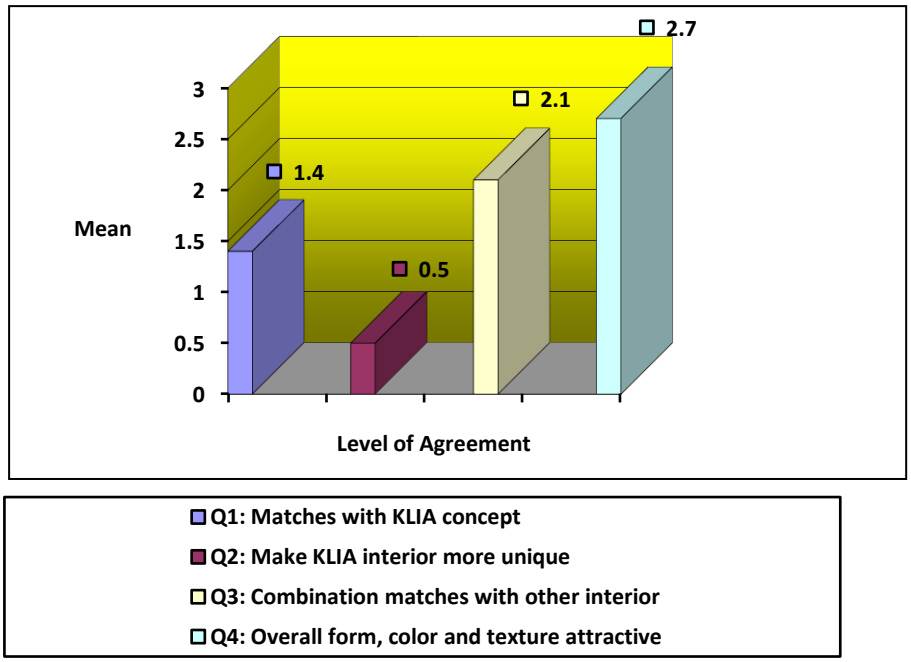


Figure 2: Observation: three users was observed sitting on the new benches for almost two hours.

Views from Design Professionals

The graph below shows findings on survey with design professionals in term of design and attractiveness of the new product. The graph attributes that the higher level of rating is on the attractiveness of form, colour and texture with an average 2.7 while the lower level of rating is on question 2 (which is on the new bench will make KLIA interiors more unique and exciting compared to other interiors at international airport around the world) with a score of 0.5. The second higher on the rate level is combination of materials used in the new bench design matches with other interior product in that areas at 2.1. The third higher of level of rating is 1.4 which is on the question whether the benches will match with the KLIA concept.

Chart 3: Designers' Views on The New Bench



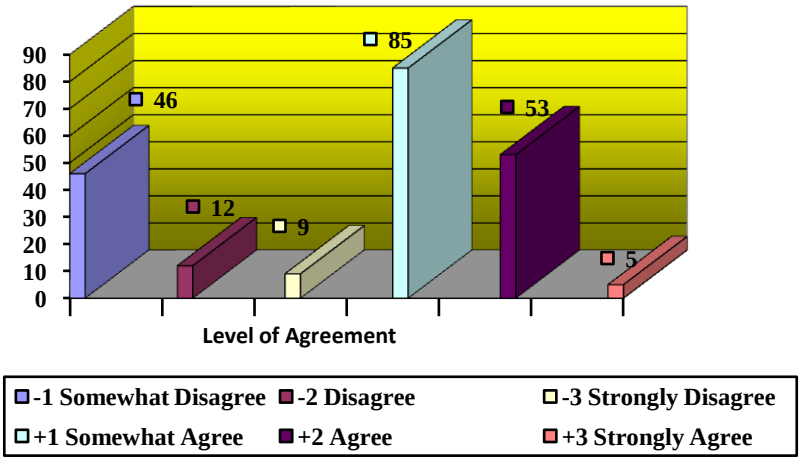
The finding shows that majority of these professionals agree on the new bench design personality. The professionals suggest that the non-skin oil palm particleboard also should be applied at other interior products inside the terminal such as paneling, counter tops and wall lining to made KLIA interior more unique. Some of them also suggest that further study should be conducted to redesign the bench to look more aesthetic besides finding solutions to increase the level of comfort of the new bench.

Table1 : The mean comparative between non-design background user and design professional perception on aesthetic value.

Mean Comparative of Perception on Aesthetic Value		
Element of Aesthetic	**Non-design Background User**	**Design Professional**
Form	+0.5	+0.4
Color	+0.1	+1.7
Texture	+0.4	+2.1

Table 1 above attributes to comparative perception between non-design background users of the new bench with the design professionals. The findings show that both categories of respondents gave approximately similar responses on the form of aesthetic value which is the mean of +0.5 for the general user and +0.4 for the design professional (both scores are on the somewhat agree category). The perception on aesthetic color and texture for both categories display different opinions where the general users give low ratings (+0.1 and +0.4) while the design professionals have high ratings (+1.7 and +2.1) on looks of color and texture of the new bench. This reveals that different opinions and judgments may occur (A. Rashid *et al*, 2004; Crilly *et al* 2004). The two highest average score shows on design professional because majority of them found that the new bench have the basic and major elements of design on the new bench which is able to attribute the design of personality on the appearance of the new bench. Besides that, all design professionals interviewed agreed that the new bench have to be improved, to make the bench more acceptable, comfortable and parallel with an aesthetical aspect. This two aspects (comfort must parallel aesthetic) are important to fulfill the users' needs and to make the new bench have a unique and different personality compared to other benches at other international airports.

Chart 4: The new bench looks interesting and attractive and has market value



The graph above shows positive response that majority of the users agree that the new benches are aesthetically pleasing and has market value. 68% (143 respondents) rated the bench as interesting and attractive while 32 % (67 respondents) disagree with the statement.

Conclusion

This paper aimed to explore the relationship and relative impacts of a new product from sustainable material with users' acceptance and emotional response. With the emergence of sustainable development, more substantive changes needed to support the effort through using alternative sustainable material in furniture industry to replace the heavy reliance on timber. Findings from this study have some important implications for our understanding of the users' needs on a new product. First, it shows that the popular assumption that emotional responses to products only relate to aesthetic (and not to functional) qualities is incorrect. Although the aesthetic emotions are an important aspect of a product, the other functions are also no less relevant. In this research, one can, for instance, be fascinated by a new material of a chair, but be disappointed by the uncomfortable seat. Users' backgrounds also differentiate responses gained where those with basic design education were found to be more selective and critical compared to layman. While designers may find the product has achieved its level of attractiveness, users may see it from different angle. In conducting the marketing survey, it is important that users' views to be accounted for readjustment of the new product to ensure it success.

This study concludes that the new bench using oil palm biomass has somehow achieved users' acceptance and could become an alternative material in Malaysian furniture industry to be expanded globally. It was also suggested that this material to be tested on other type of furniture such as wall panel. It is interesting to note that the concept of new product design with sustainable material was appealing to majority of respondents and indicates increasing concern for this type of products. Relying on the popularity of sustainable material is not enough as users' acceptance is equally important for product success. As product emotion is important to attract users, it is recommended that product emotions, such as comfort, should be taken seriously in the design process. This paper contributes towards the promotion of oil palm biomass in the production of green furniture by the Malaysian furniture manufacturers. This study found that theoretically, some elements may be thought to create good emotion individually but the combination of different elements may give opposite result. In addition, different background (economic, nationality, education and experience) indicate different responses to specific product. There is a need to further this study in understanding not only the product design and function but also on user's acceptance and response to the finished product to make the product acceptable.

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