

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**THE PRIORITIES CRITERIA OF PRODUCT DESIGN TOWARD  
AFFECTIVE QUALITY USING TECHNIQUE FOR ORDER  
PREFERENCE BY SIMILARITY TO IDEAL SOLUTION  
(TOPSIS) AND FUZZY TOPSIS: CASE STUDY  
[TOOTHBRUSH]**

This report submitted in accordance with requirement of the Universiti Teknikal  
Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering  
(Manufacturing Management) (Hons.)

by

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2014

**BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA**

TAJUK: THE PRIORITIES CRITERIA OF PRODUCT DESIGN TOWARD  
AFFECTIVE QUALITY USING TECHNIQUE FOR ORDER PREFERENCE  
BY SIMILARITY TO IDEAL SOLUTION (TOPSIS) AND FUZZY TOPSIS:  
CASE STUDY [TOOTHBRUSH]

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Author's Name : MUHAMAD HANAFI BIN KUDSI

Date : 6<sup>th</sup> JUNE 2014

## **ABSTRAK**

Projek ini menjalankan analisis tentang kepentingan pemboleh ubah pemboleh ubah personaliti sebagai hubungan tersirat bagi reka bentuk produk berdasarkan satu persepaduan kejuruteraan keputusan kepada keperluan pelanggan, terutamanya sejak keperluan-keperluan fungsian dan afektif tidak lagi memberi kuasa satu kelebihan bersaing dan sebagai satu-satunya penentu menandingi kehendak pelanggan. Terdapat 2 meninjau cara digunakan untuk kajian ini yang merupakan temu duga dan soal selidik. Terdapat 500 responden terlibat menjawab soal selidik membangunkan mengandungi 8 reka bentuk berus gigi dan 6 daripada Kansei Words. Kansei Words ialah 'Stylish', 'Durable', 'Unique', 'Simple', 'Kemas kini' (UP) dan 'Rare (RA)'. Teknik untuk Order Preference oleh Similarity kepada Ideal Solution (TOPSIS) and Fuzzy Criteria (Multi-Attribute) Decision Making digunakan perintah In menentukan dan analisis kepuasan tahap pelanggan atau kesukaan pelanggan, untuk menilai keputusan, projek ini mengambil pendekatan statistik menggunakan perisian SPSS. Tujuan ujian Post ialah untuk memutuskan ketepatan berkaitan kepada pangkat memperoleh. 30 pasca ujian soal selidik telah mengagihkan di responden sama termasuk reka reka bentuk baru telah mencadangkan. Untuk menilai data pasca ujian, ia menggunakan kaedah serupa menilai 500 responden. Bahagian terakhir, setiap objektif ditakrifkan dijawab berdasarkan tinjauan dan analisis menjalankan. Objektif utama kajian ini ialah untuk menganalisis keutamaan pelanggan ke arah reka bentuk produk dan biasa berdasarkan bahagian atau komponen menggunakan Technique for Order Preference oleh Similarity kepada Ideal Solution and Fuzzy Multi- Attribute Decision Making di pembangunan produk ke arah Kansei Kejuruteraan

## **ABSTRACT**

This project carries the analysis about the importance of personality variables as implicit relationship to the design of products based on an integration of engineering decisions to customer needs, especially since the functional and affective needs are no longer empower a competitive edge and as the only determinant to match customers needs. There were 2 surveys methods are used for this study which is interview and questionnaire. There were 500 respondents were involved to answer the questionnaires developed contains of 8 design of tooth brush and 6 of Kansei Words. The Kansei Words is 'Stylish' (ST), 'Durable' (DU), 'Unique' (UN), 'Simple' (SI), 'Up to Date' (UP) and 'Rare' (RA). Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) and Fuzzy Criteria (Multi-Attribute) Decision Making (FCDM) are used In order to determine and analyze the level of customer satisfaction or customer preferences, to evaluate the results, this project employ statistical approach using software SPSS. The purpose of the Post test is to decide the accuracy pertinent to the rank obtained. 30 post test questionnaire had been distribute at the same respondent including the new design had been propose. To evaluate the post test data, it uses the same method to evaluate 500 respondents. The last part, every objective defined is answered based on survey and analysis conducted. The main objective of this study is to analyze the customer preference towards the design of the products and characteristic based on parts or components using Technique for Order Preference by Similarity to Ideal Solution and Fuzzy Multi-Attribute Decision Making (MCDM) in the product development towards Kansei Engineering.

## **DEDICATION**

*To my beloved parents who are always supported me:*

*KUDSI BIN MUSTAFFA  
MAIMUNAH BINTI ABU NOH*

*And*

*For my supervisor,*

*MR HASOLOAN HAERY IAN PIETER*

*For my families and friends*

*Thanks for their loves and caring.*

## ACKNOWLEDGEMENT

*Bismillahirrahmanirahim...*First and foremost, all praise is due to Allah Subhana-Wa-Ta'ala for bestowing me with health, knowledge and patience to complete this work. Blessing and salutation also be on Prophet of Allah SWT, Muhammad SAW. I would like to take this opportunity to express my gratitude and apperception to the following individuals whose guidance and contribute in preparing this final year project.

Thousands of thanks to my supervisor, Mr. Hasoloan Haery Ian Pieter as know as Pak Ip for giving me opportunity to do my project under his supervised. I would like to show my highest gratitude for his invaluable support, patient, assistance, and especially his encouragement to this project. I truly have learnt a lot and all this would not be without his guidance.

I also would like to express my gratefulness to my mother, Puan Maimunah Binti Abu Noh, my late father Allahyarham Kudsi bin mustaffa, my siblings, Kamarulzaman, Siti Nor Baya and Norashikin for their constant demonstrations of love and continuous moral supports throughout my final year project.

Not forget my brotherhood Farid, Uzair, Nizam, Acap, and Kudip that always support me from behind. PUDUI



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# CHAPTER 1

## INTRODUCTION

### 1.1 Study Background

For satisfying customer needs in today's competitive environment related to the recent development condition of global markets and modern technologies, every company in those competitions have to look beyond reliability and physical quality, and pay more attention to the aesthetics and subjective quality of their products (Cross, 2000; Liu, Matsuo (2006) saw this situation involves a great deal of human-physical resources, methods, and tools for greater customer satisfaction. However, according to Desmet (2005:111), how people are to emotionally respond to the products and what aspects of design or interaction trigger emotional reactions are not much known.

In addressing this issue, Brunel and Kumar (2007:238) underlined about the design factors as a variable of companies to secure or defend their marketplace advantage. To this requirement, the companies have to respond to the voice of customer (Lee *et al.*, 2012:133). Specifically, to make how their new product successful in the marketplace through the way a product looks in the customers' eyes as one of the most important factors that affecting a consumer's purchasing decision (Yang, 2011:11382). In fact, due to they are not only involving the change and/or the improvement of the established product designs, but also involves complex activities and the use of new materials or

components (White *et al.*,1988), the companies, however, have to consider how to measure consumer response to their products based on the customers' perceptions against the product features (Coates, 2003). This is as an opportunity for them to align with consumers' aesthetic preferences, especially in the case of evaluating alternatives which are very close to the customer preferences that is not only influenced by functionality, but (Dymova *et al.*, 2013). The reason is due to consumers difficult to distinguish and choose / buy the desired products since many similar products with functionally equivalent available in the market (Yan *et al.*, 2012:326). Commented to this reality, Lee (2012:137) argued that the application of knowledge in design fields which is non-structural and how to organize the knowledge required to cope it is, actually, complex and difficult to be categorized.

Based on the

, the products should, therefore, have more to preference-related characteristics as customers accustomed to enjoy high quality products (Tsuchiya *et al.*, 1996:135). While to customer satisfaction, Creusen (2010) stated about the importance of communication and the development of product design that fits and align with the views of consumers. Blijlevens *et al.*, (2009:27) emphasized that when the communication towards the product meaning is not clear to the consumer, then consumers will have difficulty to assess the product and will appreciate the product less. Consequently, the level of importance on customer satisfaction based on

, education and preference) should relates to the product innovation that concern to affordability, production rate, technical ability, value chain, and competition (Browning *et al.*, 2003; 2006). However, since product can provide value in itself and many people like to buy a product that looks aesthetically pleasing, Creusen and Schoormans ( of product design on consumer evaluation that is often complex, then it is difficult to decide upon during the product development process.

Hence, Yang (1999:450) proposed the segregation of the product properties which contain of the basic function of

by shape, style, and color appealing to the customer's mind. Here, due to customer choice-behavior is also becoming complicated and diversified (Inoue, 2011:204), then the understanding required by companies need to be on multiple levels of consumer behavior and their perception in the evaluation of visual design aesthetics within the context of aesthetics and a holistic approach (Botschen & Crowther, 1995; Veryzer, 1999).

First, the reason is due to the design occurs in a different framework than before, with reference to social change, the conservation of resources and energy, emerging environmental problems, and customer-oriented trends (Ohira Wilhoit (2010:3) stated about the importance and relevance of each of them that are only understood in relation to its place in the overall composition. This condition creates the situation where

that pushes the producers strive for successful in attracting consumers towards their design product forced by demanding market. Demirbilek and Sener (2003) said that a product tells us something about itself and in certain cases also about the human being who owns it. The products are, however, have a message to their user. This is as was discussed by Muller (1997) related to socio-cultural message through the using of form and material that depicted a specific lifestyle of the owner of products.

In this perspective, most of the customers are having their owned desire to the consumer-oriented products, besides the product labels as sources of information designed to communicate a message of a company to motivate the consumption of customers ( is as mostly we can see from their goods at home which also more attractive and very sensitive to their personality and feelings. Through its design and function, Demirbilek and Sener (2003) added that the product do not only expresses values that importance to individuals, but also values in relation to a certain social context in terms of acceptance or rejection, liking or

disliking. For example, Creusen and Schoormans (2005) noted about a product that looks modern. This product gives positively effect on product appraisal when consumers are motivated to assess a product on its aesthetics.

in product design made by companies may lead to many inventions and thus resulting equally good quality products flooding the market, they are, consequently, to make enterprises seeking for the development of new products as an obligation in marketplace that ever-increasing demand on a product's apparent style. Based on customers' wants on the characteristics of goods, this condition create the trends of the products to more becomes shorter life cycles and to dynamically changes of the customer needs. On the other hands, marketers spend considerable time and money on packaging products in a manner to attract consumer attention through promotion towards its consumption (Héroux *et al.*, 1988). To this condition, Macdonald *et al.*, (1994) argued the companies have to put the importance on a product's appearance that should congruent with other sensory aspects of design in which 'the product forms' creates the observer expectation, while the other senses will perceive'.

Third, based on response to the products and correlating perceptions with product features, Coates (2003) stated this condition may offer the opportunity and alternative way in modifying

customers' affective needs is difficult to grasp due to product design practitioners often misunderstand to what customers really want (Sangwoo *et al.*, 2003) is because of the significance of a product in the perspective of how they present for our wellbeing was determined by an appraised concern match or mismatch. The products that match customers' concerns are appraised as beneficial, and those that mismatch to customers' concern as harmful (Desmet, 2004) to Frijda (1986), this view adheres to the emotions as instrumental considered to serve an adaptive function since they had established the company position related to environment, pulling them toward certain people, objects, and ideas, and pushing them away from others. While to a functional perspective, Ozkaramanli and Desmet (2012) customers' emotions signal is as a possible concern match or mismatch and serve

to amplify the effect of motivation by preparing companies to take action by inducing mental and/or bodily changes in action readiness. This is why functional design and ergonomic design are now no longer empower a competitive edge, rather on how to match customers' affective needs as the only determinant factor (Wu *et al.*, 2011:61)

Fourth, due relationship between the product to human emotions that play an important role throughout

quality. They guide, enrich, and provide the meaning to everyday existence (Cacioppo *et al.*, ). Particularly, to enhance the pleasure of buying, owning, and using the products (Hirschman & Holbrook 1982), even though the definition and conceptualization of emotions has not been completely clear, *e.g.* in the case of future oriented emotions (Baumgartner *et al.*,

and they are often unconscious in which thus makes the measurement extremely complex (Sørensen, 2008:1). So, the exact relation between customer satisfaction and certain emotional states, however, it seems to be individual and dynamic, and thus difficult to describe (Katicic *et al.*, 2011:666).

Fifth, a positive emotional reaction is customer satisfaction interpretations based on a cognitive standard cycle between the expectations of the customer and the perceived quality

(Risdiyono & Koomsap, 2011), (especially, since customer involvement and delivery time seems to be on the different sides), the generalizations approach, however, are useful for practitioners (Crilly *et al.*, 2004:549). This is to address the facts that the designers and consumers are often differently in interpreting the products and expressing the aesthetic preferences (Hsu *et al.*, 2000). Surely, since personal experiences as

of optimum-search activities for product design should avoid the mindset trap of individual designers whose confident to utilize their own particular 'stereotyped' design experiences when generating novel design concepts (Tsai *et al.*, 2006:158). Particularly, since



emotions act as prioritizing mechanisms in determining which concerns to follow and they can modify appraisal by changing the way a person or event is perceived (Ozkaramanli & Desmet, 2012:29) where the designers do not have much control over these apparently intangible emotional responses (Desmet, 2003:2).

## 1.2 Problem Statements

The evaluation towards each design candidates in terms of its ability to meet the demands of the marketplace is a crucial step within the conceptual design stage. Yang (2011:11382) commented that how to develop the product design which satisfies consumers' affective responses (CARs) effectively is, therefore, great importance and critical for company to survive in the marketplace. However, according to Hsiao and Tsai (2005:411), so far they are mainly addressed as a response related to the advertising and marketing. This condition has led the company trapped into the dilemma on what customers expect based on perspective of what way a product is

of the industry. The background of this situation is due to most industrial designers tend to draw upon stereotypical images and their own personal design experiences when they are generating new design concepts. An instance, Chen *et al.*, (2009) stated about a strong feeling existence of

and social behavior, while also exploring the physiological and biological processes that underlie certain functions and behaviors (Moharreri *et al.*, 2011:97).

In the opposite way against above, many firms are now turning to experiential interviews (Dahan & Hauser, 2001:11). They explore the needs and desires of customers in one-on-one interviews in which the customer describes his or her

experiences with the product class. This perspective is based on a mindset that the interviewer probes deeply into the underlying, more stable, and long-term problems that the customer is trying to solve. According to Kuang and Jiang (2009:589), this is due to companies facing the practical challenges in which the individual customers' affective needs for a product have become more important so as today's market has become a 'buyer's market'. On the other hand, according to Khalid and Helander (2004), this is due to similar products with equivalent functionalities have begun to emerge since product development technologies have become mature and competitors can catch up with the development of global markets and modern design factors.

The design factors model, however, has several shortcomings in many ways since the combination of different design factors yields a distinct perception of the design. This is a reason why many researchers are trying to investigate the important interconnection of adjectives among designers, consumers, and products (Shieh *et al.*, 2011:197). In fact, due to they are almost impossible considered to interact with the model, thus when explanatory variables correspond to each design factor and a dependent variable corresponds to quantitative measures of human perception, then there is usually an interaction or dependency between design adjectives as articulation of human sensibilities that are vague, imprecise, and difficult to understand. In addressing this issue, Chamberlain and Broderick (2007:199) underlined about the observation that it can be used to generate quantitative or qualitative data which can be recorded using machines or humans. Even though by ten to twenty experiential interviews per market segment at the customer's location as the most effective of survey since it cope the vast majority of customer needs, Griffin and Hauser (1993) stated that it is expensive to conduct. The reason is due to limitation of the session length, usually take time to an hour or less, and make inconvenience the participant or respondents.

Moreover, since products should not have their own functions and quality elements as the origins of these complex phenomena, but also something such as design that

moves, touches and impresses human feelings, emotion, and taste, as well as psychology (Nagasawa, 2006), then they should be able to partially traced in the development of modernity, and specifically, in modern consumer culture (Bengtson, 2006: , Helander and Khalid (2005:543) stated about emotions as becoming increasingly important in product semantics. They refer to Norman (2004) which discussing about emotional design that pleasure and usability should go hand in hand, as well as aesthetics, attractiveness, and beauty. That is why, Radford and Bloch (2010) stated that consumers prefer products are moderately incongruous from past offerings, and they will look for improving sequences of products. In addition, consumers will adopt new products when the arousal potential that they perceive in these products is enough to satisfy their needs for stimulation. Here, Lysonki *et al.*, (1996:11) underlined about how the decision making style of consumer in which the consumer characteristics approach seems to be the most powerful and

quality and product performance when they choose among competing products. They have a chance only to select the product that most matches their feelings (Ishikara *et al.*, 1995:13). So, they are unlikely to rely on heuristics approach to judge the quality requirements over the competitive products since consumers have finite time horizons and no incentive to perform thorough comparative studies prior to purchase. Also, according to Barnes and Lillford (2007:135), unfortunately there are only a few tools and techniques that are available for companies to support affective decision making, especially for a pre-defined stage-gated product since to change the development process in a large company is difficult due to inertia and resistance to change. Even though, the basis of analysis towards the factors influencing the users' decision for product replacement according to Nes and Cramer (2005) are such as design for reliability and robustness, design for repair and maintenance, design for upgradeability, design for product as well as the impression of a product that is quite an important factor which helps its competence ability (Nesa *et al.*, 2010).

Hence, this project carry out the analy.sis about the importance of personality variables as implicit relationship to the design of products (Reilly *et al.*, 2002:40) based on an integration of engine.ering decisions to customer needs (Allen 1986), especially since the func.tional and affective needs are no longer empower a competitive edge and as the only

. While towards how to decide the preferences of products proposed, this project employ TOPSIS to process the products alternative provided based on Fuzzy TOPSIS approach. This project also discuss about how are, actually, the consumer decision to purchase a particular product that is greatly motivated by the emotional response induced by its phy.sical appearance (Chen & Chang, 2009) since customers have difficulty articula.ting needs and the intangible aspects of products (Clark *et al.*, 1987).

### 1.3 Objectives

This project discusses about the decision making towards product design criteria based on Kansei Engineering (affective quality design) through the product development process using (Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) and Fuzzy TOPSIS. In order to determine and analyze the level of customer satisfaction or customer preferences, this project conducts as follows:

1. To identify and determine the criteria/ attribute and characteristic of the design products related to customer satisfaction and quality affective

(emotional feeling) using Kansei Engineering (KE) articulated with semantic differential (SD).

2. To analyze and justify the design and criteria of products based on customers' preferences using the approach of Technique for Order Preference by Similarity to ideal Solution (TOPSIS) and Fuzzy TOPSIS.
3. To evaluate the decision making results based on customer preferences (TOPSIS) using Fuzzy TOPSIS.
4. To propose and develop the product design through prototype made based on the results of customer preferences (decision making).

#### **1.4 Scope Of The Project**

In this project, the approaches used to determine the customers' preferences and satisfaction is focused on the tooth-brush product based on Kansei Engineering. To create a tooth-brush product that matches to customer requirements, therefore the survey required through the development of questionnaires distributed to the customers as respondents. In this project, the discussion starting with what are customer criteria required towards the design of product based on the functional, features, and affective quality (emotional design). Second, what are the approach employed to investigate the customer satisfaction and how their preference through their decision making. Based on this reason, the proposed and developed product design is expected to be successfully launched in the market.

In order to analyze and evaluate the results, this project employ statistical approach using software SPSS and Expert Choice towards the questionnaire respond from customers in Melaka, especially students of Higher Education Institution (HEI) in Melaka area. The analysis and the approach used in this project is to measure the customer preferences and what the elements of product design criteria or attributes using TOPSIS approach, while to the product design related to the emotional or affective characteristic articulated with Kansei Engineering (KE) towards the product features to uncover emotional/ feeling background of product design. Here, Fuzzy

TOPSIS approach is applied to manipulate the results data based on criteria that implicitly articulated by customer.

### 1.5 Framework

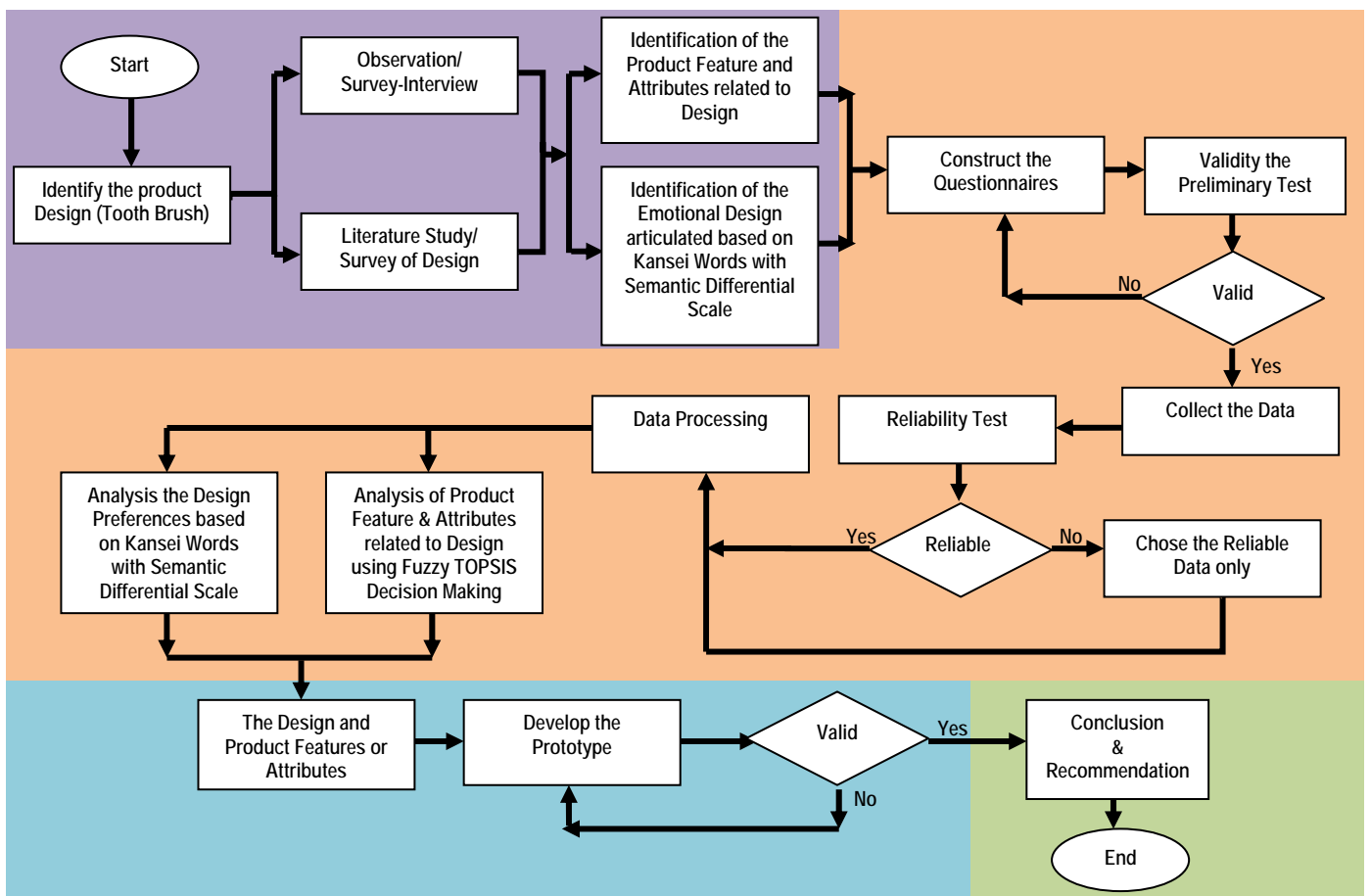


Figure 1.1 Frameworks

## **1.6 SUMMARY**

This chapter is introducing the project background and the objective of the project. In addition, the problem statement and scope of study also being clarify in order to limit the range of this project conduct. The following chapter consists of the literature review and knowledge that required in conducting the whole study.

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