Preferences of Profile Design Product Using Kansei-Pairwise Analysis

This report submitted in accordance with requirement of the University Teknikal Malaysia Melaka (UTEM) for the Bachelor Degree of Manufacturing Engineering

(Design)(Hons.)

By

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTEM as a partial fulfillment of requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Design) with Honors. The members of the supervisory committee are as follows:

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ABSTRAK

Tujuan kajian ini adalah untuk mengenal pasti dan menyiasat perasaan emosi pelanggan tentang produk berdasarkan kepuasan pelanggan dan keutamaan dalam perbezaan semantik berbanding imej ke arah Kansei Kejuruteraan. Projek ini akan menganalisis perasaan pelanggan emosi dan tanggapan mengenai produk (reka bentuk kereta), melalui kajian yang dijalankan terhadap 210 orang pelajar pengajian tinggi, kakitangan di Universiti Teknikal Malaysia Melaka (UTEM) dan warganegara Melaka. Terdapat tiga jenis reka bentuk kereta yang digunakan dalam projek ini, manakala soal selidik yang dibangunkan adalah untuk menganalisis reka bentuk kereta atau bentuk produk kereta sebagai satu faktor penting dalam perniagaan automobil. Data kereta akan diikuti dengan garis luaran kereta menggunakan pendekatan matematik dalam parameter lengkung bezier dalam perisian Geogebra. Dalam projek ini, Statistical Package For Social Science (SPSS) digunakan untuk menganalisis jawapan responden untuk data statistik berdasarkan apa yang pelanggan keperluan apabila mereka membeli produk dan juga apa sifat-sifat yang berkaitan khusus kepada keutamaan ciri-ciri mereka kepada reka bentuk kereta. Terdapat 5 daripada 20 reka bentuk untuk setiap jenis kereta yang pilih oleh responden kerana kebanyakan profil reka bentuk keutamaan. Sementara itu, bagi Kansei Word, 5 daripada 10 Kansei Word telah dipilih oleh responden untuk mewakili profil reka bentuk. Selepas analisis data diperoleh persamaan Matematik telah dibangunkan dengan menggunakan Microsoft Excel. Berdasarkan persamaan matematik keutamaan Kansei perkataan untuk setiap jenis kereta telah ditentukan di mana kuadran. Untuk kereta bandar mewakili dalam kuadran 1 dan kereta Sedan mewakili dalam kuadran 2.

ABSTRACT

The purpose of this study is to identify and investigate the customer's emotional feelings about the products based on customer satisfaction and preferences in semantic differential versus image toward Kansei Engineering. This project will analyze the customer emotional feeling and impression about the product (car design), through the survey conducted towards 210 higher education students, staff at Universiti Teknikal Malaysia Melaka (UTEM) and citizen of Melaka. There are three types of car design used in this project, while the questionnaire developed is to analyze the car design or shape of the car product as an important factor in automobile business. The car data will be trace by its outline car by using mathematical approaches in bezier curve parameters in Geogebra software. In this project, the Statistical Package for Social Sciences (SPSS) is used to analyze the respondent's answers for statistical data based on what customer's needs when they purchase a product and also what the particular related attributes to their preferences characteristics on car design. There are 5 out of 20 designs for each car type that choose by respondents as the most preference design profile. Meanwhile for the Kansei Word, 5 out of 10 Kansei Word were chose by the respondents to represent the design profile. After data analysis were obtained the Mathematical equation was develop using Microsoft Excel. Based on mathematical equation the preference Kansei word for each type of cars was determined in which quadrant. For the city car represent in quadrant 1 and Sedan car represent in quadrant 2.

CHAPTER 1

INTRODUCTION

1.0   PROJECT BACKGROUND

Nowadays, the preference and the identification of customer taste towards the product attributes become one of the most important factors of the company's strategy (Zhai *et al.,* 2009:295). On how they can deliver the products to the market successfully, companies in the competitive market are therefore necessary to pay their attention on anticipation and innovation strategy through continuously improve their process and products development in order to effectively meet the customer requirement based on functionality and affective (psychological) needs against the products (Khalid, 2001; Marghana *et al*., 1997; Tsuchiya *et al*., 1996). In this context, it has become an important and also the primary concern on their business run to carry out the user-oriented product development and design as a key factor in elevating the design competence (Chen *et al.,* 2009:2689). This meant that the product should not only be comprehensively assessed towards customer needs, value and their desires (where a format of consumer-oriented new product development and technique should meet the trend), but also on how to explore the relationships between people's emotional feelings and artifacts' characteristics. In simply, Chen *et al.,* (2009:50) said that this is due to emotional factors on consuming products become trend of current global market competition.

In accordance to the proportion satisfaction towards basic requirements, Mamaghani (2010) argued that customers do not only seek for goods that will satisfy their physical requirements, but also those which are valuable to their desire and would fulfill their psychological needs, such as feeling and emotion. Philosophically, the context of this product design concept has shifted from manufacturer-oriented to customer-oriented. This reason

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trigger the challenges for producers and designers to manipulate the emotional impact of the product designs that are often considered as intangible and impossible to be predicted in the future (Desmet, 2003:4). Even though, the expression of emotion articulated on the design of product is a simple feature, like the handedness of a gesture that may be correlated with a person's emotional state (Kipp *et al.,2006*). However, since the emotions and 'the agent's' decision making need the deliberation processes, in order to make the product is successful in the market, therefore it is necessary to make it explicit in both sides of the need; subjective and objective. An instance, on how to deal with usage functions since there were systematic methods required in engineering design to obtain successful products. Whiles, on how to ensure the development of product in a rational and scientific way to describe users' perception (Mamaghani , 2010).

Since the concept of successful product should be based on the customer's satisfaction, therefore the design of the product need to be more emphasized on attractiveness towards the customer (Huynh *et al.,* 2006). A satisfied customer is likely to intensify its relationship with the company by buying more products from the company. This is the reason of why several companies make a regular basis of surveys to measure the changes level of satisfaction their customer (Vanhamme, 2002). Therefore, since the key to success of product towards customer satisfaction is triggering more interest of companies to realize this critical point of view, there is a new approach suggests that industrial design engineering towards the product design should be achieved by the efficient action and processes through structures obtained from the interactions between an object and its user (*i.e*, originality and familiarity in the aesthetic appreciation of industrial design (Hekkert *et al.,* 2003); Aesthetically beautiful and attractive to improve the quality of the industrial design (Miura,2006:653) ; Genotype as genetic representations of human evaluations based on the individuals' fitnesses from the previous generations (Wannarumon *et al.*, 2016:2); Structure Mental Process (Liang *et al.,*2010:3); Design Structure Matrix (Huang *et al.,* 2012, etc). This meant the designer should not only consider to the useful function of an object on how it can be achieved, but also on how to add an information required on an object that make it possible to perform (Duarte *et al.,*2008). In addition, the fundamental of customer satisfaction should on a philosophy of action focused on the customer where the design's purpose is not enough concentrated on functional analysis only. In this context, the traditional of product-oriented should be transformed into the product

design concept that directly or indirectly determines the final purchase behavior (Guo,2001). Also, a product's design is not only based on the designer's artistic sensibilities, but on how to manipulate the product form features related to specify styles that satisfy the consumer's expectation (Yang *et al.,* 2011:174).

Furthermore, since consumers' aesthetic appraisal of products depends on the presence of certain product design properties in the product design (*e.g.*, colour, shape), there were the properties and characteristics of different cognitive and affective processes need to be recognized towards an aesthetic appraisal. First, the typicality of perception related to a cognitive process (Veryzer & Hutchinson, 1998). Second, the experience arousal is as an affective process (Berlyne, 1960). Since the people may consciously search for a typical product designs, therefore the people consider a typical product designs as more attractive than highly typical designs (Baumgartner *et al.,* 1996; Schoormans & Robben, 1997). In this context, according to Armstrong & Detweiler-Bedell (2008), a typical product designs are positively appraised as a result of successfully expanding knowledge. Therefore, to know who the customer is and what the customer wants, the company need to know what and why the customer wants that depends on the product attributes identified and how its importance to them. This is what emphasized by Dickson *et al.,* (1996) related to market segmentation and product positioning as a deal attention in marketing research.

Moreover, since designing and marketing aesthetic products is growing importance in markets, Reiman *et al.,* (2010) argued that there were necessary to know how to measure and analyze human reactions to affective design and to assess the corresponding affective design features. In fact, design and aesthetics are said to be major differentiating attributes in the choice and preference of consumer goods (Zolli , 2004). Since the good design and good quality are not enough to meet customer's requirements, therefore the designers need to deal carefully with possible interaction problem between customers and product interfaces where the design of product should reflect to the customers' emotional requirements (Huang *et al.,* 2012: 418). On how they evaluate, Tanoue *et al.,* (1997) suggested about the sensibility and the expertise of the designers involved. In this perspective, Nagamichi (1995) defined it through Kansei Engineering which translates the technology of consumer feeling towards the products that are "able to touch the heart of customers' emotions and capture the culture and reason of expectations. Here, there were integrating of the consumer and designer into the

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process for design and evaluation were required due to, as stated by Tscuchiya *et al.,* (1996:135), there were communication interacted occurs between designer and customer, customer involvement to support the selection of products, and the designer concern focused on the evaluation of product design.

In conclusion, since the changes of customer needs plays an important roles in developing a good product in competitive market, therefore the product development perspectives should not be only focused on the benefit value of product based on its functionalities (Marghania *et al.,* 2010; Shieh, 2011:205). This meant that the companies need to concern in various ways where the design of product should more accurate based on design requirement (Pikhatiratham *et al.,* 2012:198; Lokman, 2010:1), and also on how design changes will affect the environmental performance of product concepts in design process (Sausa *et al.,* 2006). Since the main challenge of effective design is to take the customer's effective needs accurately and subsequently to the design of products (Helander *et al.,* 2005 : 659; Jiao *et al.,* 2006), instead of product design has depended on designer sensibilities are successful in the marketplace, the real situation show us that way cannot meet the customer requirement effectively.

1.2   PROBLEMS STATEMENT

The problem occurred and the difficulties faced by the designer were related to the feelings expression represented of each individual emotion (designers and customers). Therefore, since emotions and feelings are often as a result of external sensory stimuli provided to the human mind via the human emotions becoming a trend in global market competition, there were human mind as a purely objective sensory information is necessarily need to be interpreted to the basic emotional reactions (Damaiso, 1996:300 ; Gobe *et al.,* 2001:50). In this case, due to the product should satisfy not only requirements of physical quality, defined objectively, but also consumers' psychological needs, by essence subjective (Petiot *et al.,* 2004). However, since how to develop the product design that can satisfies consumers' affective responses (CARs) and the greatest challenge due to the manufacture is

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based on the traditional approach, there were so many product design studies faces difficulties on how to carry out a better insight into consumers' subjective perceptions where the consumer's purchasing characteristic or criteria are more to preference-related (Han *et al.,* 2004). This is due to consumer's needs and feelings related to enjoy feelings and expression is as a representation of high quality product (Namagachi *et al.,* 1996). In this perspective, according to Liang *et al.,* (2010), a good design not only must function well, but also should appeal to the users. However, because users' emotional feelings about any object are so subjective, there is no single standard to judge the appropriateness of any design.

First, even though Kansei Engineering procedures were based on psychological evaluation and multivariate analyses that advanced by incorporating artificial intelligence approaches (such as neural networks, genetic algorithms, and rough set theory) and by including various computer graphics (CG) techniques (such as 3D CG and virtual reality or VR) (Tatsuro *et al.,* 2005:2), however Chen *et al.,* (2000:2-16) stated that Kansei Engineering (KE) that plays as a consumer-oriented new product development technique, required a format that can plays as a key factor in elevating design competence based on user-oriented product development and design. Particularly, due to emotions and feelings are often a result of external sensory stimuli provided to the human mind via the human senses (Dahlgaard , 2003). Here, since affect is a basis for the formation of human values and human judgment, then product design that do not consider affect are essentially weakened (Helander & Tham, 2003; Jiao *et al.*, 2006). But, since the need to develop individually distinctive styles has forced designers to produce a large number of innovations, there were some necessary features need to be addressed from a psychological point of view in order to understand the aesthetic experience comprehensively (Leder *et al.*, 2004:2-3).

Second, since the Kansei adjectives are clustered based on the customers' voices/opinions (Huang *et al.,* 2012:418), there were current design methodologies for design have been seeking new methods that allow the generation of innovative ideas (Marghania, 2010). This conceptual framework extends Kansei Engineering from pure product design to working backward to design specifications. To integrate the consumer and designer into the process for design and evaluation, therefore it requires the semantic differential (SD) experiment conducted by asking consumers to evaluate product samples using chosen adjectives (Han *et al.,* 2004). Also, to observe and analyze human mental activities, there were

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appropriate tools required towards cognitive psychologists. Kim *et al.,* (2004) specifically in their research focused on design as an information cycle which includes informative, generative and decision-making phases (evaluation-selection) whose outcomes are intermediate representations (IRs) and iterates evolutionarily. In this perspective, Goggina (2006) stated about 'customization' towards product design that bring these to bear on the cultural adaptation framework is as a fruitful process. However, to discover the mapping pattern between consumer affections and product design elements from raw design data become the challenging issue of affective design that is usually characterized by non-linearity and uncertainty (Zhai *et al.,* 2009).

Third, according to Shichuan *et al.,* (2014), there are different categories towards facial expressions of emotions which correlated to human cognition and affects related to design. Todorov *et al.,* (2005) commented that there is a direct correspondence between facial appearance and personality refers to beliefs in the culture. Also, the human face holds to the key of information which will revealed about the identity, age, sex and ethnicity and the information that enables us to identify the individual (Fraser *et al.,* 2003:123). Posamentier *et al.,* (2003) defined the face based on information taken where the face belong to unique individual expressions related to appearance and aging, while in the emotional context represent the sets for the social interaction. In this perspective, since the face is a window to a person's true nature and the metric and morphological analysis of the human face is considered one of the most promising methods for personal identification on images (Todorov *et al.,* 2005), however the combination of human facial expression features is a new idea and not yet been exploited (Tsai *et al.,* 2009). This is a reason on why the facial assessment (since emerging science of biometrics) becoming importance for the forensic sciences where the new methods and techniques were required to validate the personal identification, besides the accuracy and reliability of identification system (Fraser, et al., 2003:123; Gibelli et al .,2012:451). Here, the integration of different human biometric characteristics and facial recognition is not a new idea, but the numerous fields of application towards the personal identification were usually performed without precise information concerned on changes (Armann *et al.,* 2012). In fact, the facial recognition still suffers from many common problems of intra-personal variations under illumination, poses, and/or facial expressions which degrade the recognition performances (Pohsiang *et al.,* 2009). An instance, Shichuan *et al.,* (2014)

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stated the facial expressions of emotion that were divided into six basics categories which are, happiness, surprise, anger, sadness, fear, and disgust. The different face expressions such as sad or smiling face via the cognitive process (called categorical perception) for the specific case of face perception, the categorical perception has been found by created morphing images between realistic human faces of different identities. In addition, since the asymmetry functional in facial beauty and a difference in its manifestation towards woman's and man's faces were existed, to think about aesthetic judgment towards facial beauty based on subjective impression is caused by lack of an anchor in the brain's functional neuro-anatomy. Moreover, since there were many more facial expressions existed besides the facial movement involved (where should be different from the other expression) through the muscle activation (that should be sufficiently different between each categories of emotion), the facial asymmetry is not easily noticed in an ordinary social context (Chen *et al.,*(1995).

Based on aforementioned problems, the study conducted will explore the customer preferences on the product design based on Kansei Engineering using semantic differential where the concept of customer preferences and their characteristic will be recognized through the statistical analysis and image processing related to physiognomy concept, cognitive style, and the image processing.

1.3 OBJECTIVES

In car designing, the customers play an important role in determining a product market which will make the certain products is either successful or not. Therefore, to produce a design that will grab and win attention of the customers, Kansei Engineering (aesthetic and emotional) is used to identify, analyze, evaluate and develop the product based of customer's feeling. There are several objectives of this project, which are:

a) To investigate and analyse the profiling design preferences through mathematical approach using parametric equation based on De Casteljau's algorithm on Bezier Curve.

b) To identify and determine the emotional feeling of the product design related to customer satisfaction and preferences using Kansei Engineering.

c) To evaluate the customers aesthetic emotional based on product profile design.

1.4   SCOPE OF PROJECT

The scope of this project focuses on the study and analysis the facial characteristics of product design to determine the customer satisfaction and the feeling of customer towards the product characteristics. The feeling of the customer will be analyzed by using Kansei Engineering (aesthetics and emotion) process conducted by questionnaire. This study mostly investigates on the emotional response for aesthetic design characteristics of car products. In order to achieve customers responses and opinion, Semantic Differential and is been using. The design features used in this project is to achieve the favorable design of cars based on what customers wants. Mostly, the respondents that answer the questionnaire are persons that own a car. Furthermore, the external appearances of the products are main factors, the assessment is conducted based on convolution design. Last but not least, User' satisfaction towards the product design characteristics based on the contour of product design evaluation using mathematical approach (parametric equation based on De Casteljau's alogorithm on Bezier Curve) and Kansei Engineering approach.

CHAPTER 2

LITERATURE REVIEW

2.1 Aesthetic

Aesthetic is a concern about the beauty and appreciation of the beauty. Based on Ulrich (2006), the immediate feelings in product design evoked when experiencing some artifact via the sensory system that show towards the aesthetic response. Ulrich (2006) also explained that the aesthetic response differ from other cognitive response. But, Leder (2004:489) argued that the aesthetic responses are frequent in the modern life where there are no scientifically comprehensive theory that explains what psychologically constitutes such experiences. For the aesthetic perception, it does not only represent sense perception of a work of art, but we also apply the cognitive response in which experiencing of the listened or seen and assessment (Kišoňová ,2013). Ulrich (2006) defined the different of aesthetic response and other cognitive response into three ways as follows:

- Aesthetic response is rapid, usually within seconds of exposure to the artifact.
- Aesthetic response is involuntary, requiring little of any expenditure cognitive effort.
- An aggregate assessment biased either positively or negatively and not multi-dimensional evaluation.

Leder (2004:489) stated that the aesthetic response experienced were particularly interesting because of their hedonic properties and the possibility to provide self-rewarding cognitive operations. He also said that the positive aesthetic experiences in the modern arts are based on the large number of individualized styles, innovativeness and conceptuality. The aesthetic experiences involved in five stages, which are perception, explicit classification, implicit classification, cognitive mastering and evaluation. In aesthetic perception, Kišoňová (2013) said that the aesthetic perception elements are termed as aesthetic response. The emotional experience basically embodies completion of perception and cognition of a work. Aesthetic perception requires a human being prepared for an act of perception. Leder (2004:489) stated that aesthetic response is most frequently stimulated by visual information, largely because the vision system provides data more immediately and at higher rates than do the other senses. Nevertheless, aesthetic responses can be stimulated via senses other than vision.

Kišoňová (2013) said that the humans differ in aesthetic perception and assessment, and that is what inspired aestheticians, art psychologists and artists to determine various types of aesthetic cognition. In her study, she introduced a well–known typology of aesthetic perception in Table 2.1.

Table 2.1: Typology of Aesthetic Perception

No	Type	Description
1	Descriptive	This type focuses on description of details, does not try to define their sense and relations.
2	Observation	This type of percipient catches only significant features of an aesthetic object and evaluates them.
3	Erudite	This type does not try to describe or analyze an object, but rather introduces everything what he knows about it.
4	Emotional (Imaginative)	This type attempts to capture emotional meaning of an aesthetic object into six types: descriptive, observant, emotionally descriptive, emotionally not always real motion; frequently only images of motion are present.
5	Imaginative	This type of percipient or creator an artistic object represents an outcome of rich fantasy activities.
6	Intellectual	This type of percipient or creator puts intellectual processing of experience in the foreground.
7	Emotional	This is a type who lets someone be enchanted by his emotional experiences.

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Leder (2004:489) stated the theory about the aesthetic design as follows:

- The phenomena that lump together into aesthetic response are actually the result of many different cognitive mechanisms.
- These cognitive mechanisms operate on basic sensory inputs and on symbols derived from these inputs and from memory.
- The cognitive mechanisms that are consider aesthetic have short time constants and may be superseded by a more deliberate formation of preference based on analysis over longer time periods.
- Some important and significant aesthetic responses are vestigial adaptations for detecting physical features that were useful in an evolutionary sense.
- Other important and significant aesthetic responses are adaptations that operate on symbols derived from learning, experience, and cultural context.

All of the aesthetic thinks and feelings about states of the world come from our own body from the sense organs. Dixon (1986:237) stated that without our sensory organs, the information could not be passed to us, and there were no knowledge without sense. All of the knowledge that we gained was constructed from the experienced sense.The cognitive significance of the term aesthetic is as a term of cleavage, contrasting with formal knowledge. Based on Jacobsen (2010), usually someone are more comfortable with making aesthetic judgment about paintings, sculptures, buildings or melodies, which are much more complex. These, however, mostly combine variations of a multitude of stimulus dimensions that hamper adequate experimental control or even render it impossible. Jacobsen (2006) stated that the framework for the psychological study of aesthetics The framework for the psychological study of aesthetics. Each vantage point can have different levels of analysis, which are not mutually exclusive. Figure 2.2 shows that illustration of a framework for the Psychology of Aesthetics. The topic is viewed from seven different vantage points, which are not mutually exclusive. These are called: diachronia, ipsichronia, mind, body, content, person and situation. Eventually, this work can converge on a unified theory of processing aesthetics. Diachronia is

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the perspective that takes change over time into account. Ipsichronia is the vantage point focusing on comparisons within a given time slice, i.e. comparisons between cultures, subcultures or social systems
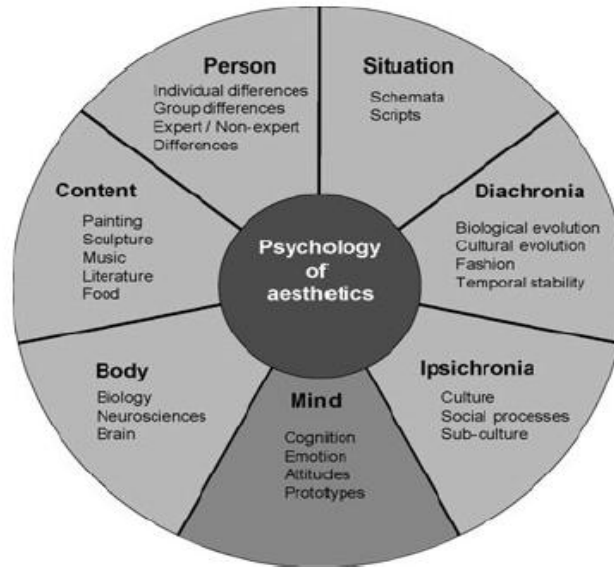

Figure 2.2

2.2   Semantics Differentials (SD)

Semantics is part of the study of signs and symbols. In the study of linguistic, there were focused on the structure of the languages. According Bauerle *et al*., (1979), the word comes from the Greek semantics. Technically, the word semantics are defined as the study of meaning. They added that semantic analysis assumes the language consists of a structure that reveals the meaning when associated with objects in the human experiences. The semantic recognition and its rule-oriented are proposed for developing a product design (Hsiao, 1997). This method was employed to examine the relationship between the subjects' evaluation and the users' perception of product form (Osgood *et al*., 1957).

Hsu (1999) argued that the reason of semantic recognition method is to investigate the differences between designers and users in perceiving product form. According to Demirnilek (2003), there were product semantics existed relationship between user and the product.

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