UNIVERSITI TEKNIKAL MALAYSIA MELAKA

APPLYING A CRISP AND FUZZY ANALYTIC HIERARCHY PROCESS METHOD FOR SPATIAL MULTI-CRITERIA DECISION ANALYSIS

[CASE STUDY: SPECTACLES PRODUCT DESIGN]

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

by

SUMAIYAH BINTI ABDUL LATIFF
B050910056
890922-07-5584

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Alamat Tetap:
NO 2, JALAN PELATA HILLSIDE
11200 TANJONG BUNGAH,
PULAU PINANG.

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APPROVAL

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

........................................
Haslohan Haery Ian Pieter
(PSM Supervisor)
ABSTRAK

ABSTRACT

This study is about product design features based on customer requirements using a crisp and fuzzy analytical hierarchy process (AHP and FAHP) method. In this study, the respondents involved were the higher education students in Melaka. The survey conducted towards 1000 respondents with the questionnaires developed using the 3 proposed design characteristics, that were containing of 6 design types respectively applied in the scaled 1 to 7 of semantic differential to Kansei words. The objective of this study is to identify, analyze, justify, and evaluate the features and design requirements of the product, beside to generate the decision making in order to find the preference or priority of the products. As a case study, this study was conducted towards the spectacles design. The Post Test survey is required in order to validate the results, beside the correlation analysis. Based on the results data, all of the Kansei words used in this study were valid, since all of the Cronbach alpha values were more than 0.7. The Kansei words identified through 30 respondents, as the articulation of the product design characteristics are ‘Boring – Attractive’ (B/A), ‘Common – Unique’ (C/U), ‘Lame – Cool’ (L/C), ‘Classic – Modern’ (C/M), and ‘Fragile – Robust’ (F/R). While the most preference design characteristics related to the proposed design, is Full Rim characteristic. To the Kansei words, the most preference was on “Lame- Cool” (L/C) word, where the highest value was occurred on the type-6. This finding is similar and proven through the Post Test survey conducted. Towards the respondents’ background, the ‘Optical Power’ is having significant correlation (p<0.01) to ‘Boring-Attractive’ of Kansei word. Based on this reason, the decision made to customer requirements should be carefully determined by the comparison analysis, especially to each criterion using Kansei Words as an articulation of customer quality feelings.
DEDICATION

For my beloved parents who are always supported me:

Abdul Latiff Bin Abdul Rahman
Merduwati Binti Mustafa

And

For My Supervisor,

Mr Hasoloan Haery Ian Pieter

For my families and friends

Thanks for their loves and caring.
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CHAPTER 1

INTRODUCTION

1.1. Background of Study

In today’s global and dynamic competitive environment, the competition among market players becomes more severe. In business globalization, according to Lin and Luh (2009:191), consumers’ requirements become more complex and the high technology development led to vigorous business competition and market uncertainty. In facts, the rising of customers’ expectations are largely influencing the companies’ experiences to a boundless commercial world. In order to continuously maintain customer satisfaction for long-run profitability, according to (Heffernan & LaVelle, 2006:1), the trend of business to globalization competitors have been moving from national to regional and, thus, international market. Due to this reason, the competition among industries related becoming increasingly intense. They are not only compete on how to provide products with high quality (Shen et al.,2000:91). Matzler and Hinterhuber (1998:25) defined this competition as a focal point of how to capture market share through the attraction of new customers as an offensive strategy, where the delivery of innovative products to the
marketplace is, thus, considered as a key element for a company to confront competitive challenges (Shen et al., 2000:91).

Viewing on this condition, to achieve or sustain a competitive advantage, Bettis and Hitt (1995:7) argued that the rapidly development of product and process innovations are, therefore, becoming important task in global industries. Beside on how the companies deliver the product innovation that should be more relevant to markets (according to Alegre et al., 2006:333 is as result of three major trends such as intense international competition, fragmented and demanding markets, and diverse and rapidly changing technologies), the ways of companies to meet these challenges also depends on the nature of their business, the dynamic forces of the market in which they operate, and the resources and skills that can be applied to ensure their business objectives are met (Shepherd & Ahmed, 2000:100). Voelpel et al., (2005: 37) stated that to counter direct competitive challenges, the companies have to continuously learn new ways of improving their efficiency and performance. This is due to a successful product launched to the market will soon be followed by its competitors with others value added products offered.

On the efforts for implementing the innovations (that was initially interacting with the normative evaluation as multi-level and are espoused “common sense” or “normalized knowledge”), according to McAdam (2005:384), the conformity based on the evaluation elements of the innovation should be as the comparison toward the existing norms. Govindarajan and Trimble (2006:1) said "today's business importance task is about how to find the νεξτ ανάπτυγκα δεν το επεξηγηματικης στατις απο το δευτερημα της δεξιωσης στη μεταγενεση στη δεξιωση της δεξιωσης. Της μεταγενεσης, απο της κοινετωσης και της τριβής της προμηθειας οι διαδικασίες της μεταγενεσης, ιδια στην περιοχή της ηλεκτρονικής και των τεχνολογιών, εν μέρει επικεντρωθεί στο κέντρο της αντιπολίτευσης του εμπορίου που γίνεται, προς την χρήση της και την προσαρμογή της στην πλατφόρμα της αντιπολίτευσης της και την αντιπολίτευση υποστήριξη και πιθανότητα θυγατρικής αναπαραγωγής.
Based on this reason, Hizon et al., (2006) commented that the company must to be master with new competencies and utilize the most appropriate forms of technology in each phase of their business life cycle. This means that the companies, are consequently, requiring the product development competencies, which is not only lie on more effectively than they have in the past. They also should have as follows:

- A key adjustments identified and implemented to support the new "solutions" focused business model (Shepherd & Ahmed, 2000:100). This is due to a company's survival in rapidly changing condition and highly competitive circumstances depend on the timely design and the development and marketing of new products or services with creative and innovative features (Shen et al., 2000:91).

- To guard themselves from obsolescence or ossification by offering processes, systems, products, or services not previously observed in a market. This means that to drive their business sustainability, they must be better integrate and align the way they treat customers with their go-to-market strategy and branding at each touch point of the relationship (Heffernan & LaVelle, 2006:1). For instance, companies turn their strategy to a "solutions" focused business model in order to counter the effects of decreasing technology and product life-cycles, tightening margins, and increasing commoditization of product components (Shepherd & Ahmed, 2000:100).

- The strategic intent against the competitors that are not only enough to capture higher market shares, but to also on how to gain sustainable competitive advantages within certain market segments, where the core competences of the firm can be exploited, and to create a high level of customer satisfaction and loyalty (Matzler & Hinterhuber, 1998:25). This is due to the achievement of quality attributes does not always improve overall customer satisfaction, and not all service attributes are viewed as equally important to customers (Lin et al., 2010:255).

- The target values determination of the engineering characteristics. Since they are complex problems with multiple variables and objectives that needs to be trade
off all kinds of conflicts and constraints (according to Zhaoling et al., 2008:1165) are the conflicts among the engineering characteristics and the contradiction between the customer needs and design budget), then the exploration of customer satisfaction model should be taken through a comprehensive perspective (Lin, 2007:110).

Hence, what the companies do their business should have against the product development related that must consider not only the technological satisfaction of consumers, but their affective needs as well. First, this is due to, according to Kim et al., (2010:527) the affective need is greatly influenced by the appearance and performance functions of the products. Whether consumers choose a product, it depends largely on their emotional feelings of the product image (Lin et al., 2004; 2005). Especially, due to the product image plays an important role in consumers’ preference and choice of a product (Chuang et al., 2001). On this reason, emotions mainly are conveyed through the semantics of an object. They follow a complex process including how the visual stimulus answers to customers’ values, but also attributes and design elements (Kongprasert et al., 2009:1)

Second, according to Oztekin et al., (2011:1), to better serve the customer and create superior customer value, thus it is most helpful to know who the customer is and what the χρήστης οκινεί. Της θεωρίας ως της χρήστης αποτελεί το μαρκέτ σημαντικό να το οριστεί μαρκέτ. Οι της θεωρίας ορισμοί της χρήστης οκινεί επεξεργασία υποχρεωτική ανα βερτίσμα εμπεριακά της της χρήστης ορισμοί μαρκέτ το σημαντικό. Ωστόσο το μεντ μετά χρήστης νεών ένα προϊόν η αποτίστη η περιοδεία το της της χρήστης σημαντικό το περιοδεία το της προϊόντος (Liv et al., 2004:898). Ον της ποινής ή διάλεκτων, της ρεπορτάζ σε υπό βερτίσμα το χρήστης αποτελεί μαρκέτ τον της προϊόντος δεσμεύεται (Konkpropert et al., 2009:1). Η διάλεκτη, σινέχει της προχείρως η αποτίστη υπό σημαντικό να ορισμοί της της χρήστης αποτελεί μαρκέτ δεσμεύεται ένας μεσολαβητής και αυξάνει the key to achieving
emotive success is how to understand the customers’ needs and expectations. Here, Shen et al., (2000:92) underlined that a deep understanding of customer satisfaction is a prerequisite to achieving customer satisfaction. For example, Dröge et al., (1997:18) proposed the consumer satisfaction/dissatisfaction (CS/D) models pertinent to the consumer choice as a given and specify satisfaction to be a function of antecedents relative to the alternative already chosen. Whilees, Vahidnia et al., (2008:593) suggested about some spatial planning or spatial problems that can be considered as a multiple criteria decision making or multiple MCDM problems involve a set of alternatives that are evaluated on the basis of conflicting and incommensurate criteria.

Third, Aya’g and Özdemir (2009:180) said human assessment on qualitative attributes is always subjective and thus imprecise. Due to in the real situations are, in facts, the information incomplete or imprecise to deal with problems (such as how to explore issues, how to describe a shared scenario, and how to realize the scenario for testing from design disciplines that can be useful to improve “vision” thinking for product design innovations), and also the linguistic assessment of human’s feelings and judgments are vague and difficult to represent as crisp numbers, then the judgment should be taken carefully. Here, Chou et al., (2007) commented about the using of interval judgments or fuzzy evaluations as an alternative solution. Rather on fixed value, they stated that fuzzy approach seems resulting with more confident. By considering this reason, according to Singh (2009:1), the fuzzy numbers or linguistic values characterized by fuzzy numbers used to convey the assessments of human’s feelings and judgments are therefore required. Especially, in setting the priorities so that it will make the best decision when the both qualitative aspects of a decision need to be considered. An example, the synthetic extent analysis method of fuzziness-based analytic hierarchy process (AHP) approach so-called as fuzzy extended AHP (FEAHP). This approach is to address the complex decision problems, according to Meixner (2005), where there is a large number of decision makers (group decision in multi-criteria decision making or MCDM) and when there is a need to follow human behavior. This is due to fuzziness comes closer to reality compared to classical evaluation processes using crisp data. By
using fuzzy approaches for decision making, according to Chow and Luk (2005:280), it will enable the decision-makers to make choices among a number of alternatives and criteria based on the formulating priorities and a series of tradeoffs.

1.2. Problem Statements

Today's business world is very competitive markets where a successful product on the market will soon be followed by the competitors. In terms of business strategy, it is, therefore necessary for the company to improve their marketing strategy to survive in the current market. Especially, to the condition of markets where many players offers the products that consumer sees it as an alternative uniformity to the products in the market and as a choice of the desired product. In this condition, the customers tend to choose other products due to the number of product standardization in the market becoming abundant. However, the products that have its owned distinction, it will be able to attract the attention of consumers and help consumers to make decisions compared to products with similar functions in the market. Based on this reason, the difference of the products should be, therefore, achieved by a company through delivers the customer with the good product quality. This is due to the different products on the market if it is not coupled with a good quality, it will not be enjoyed by consumers.

Considering on this reason; where the customer satisfaction (CS) is a central issue of today's business and its imperative task in organizational performance to survive in hypercompetitive market, the overall customer satisfaction should be therefore determined as an indicator of a more fundamental relationship to the performance of the firm as a result of the behavior of the economy and benefit the firm (Anderson et al., 1994). Various studies found that the level of higher customer satisfaction leads to greater customer loyalty (Anderson & Sullivan, 1993; Bearden & Teel, 1983; Bolton & Drew, 1991; Boulding et al., 2009). Via loyalty is increasing, it is argued, customer satisfaction help for future earnings, (Fornell 1992; Rust et al., 1994.1995), reduce the