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A Study of Product Design Using an Integration of Conjoint Analysis and TRIZ (Teoriya Resheniya Izobretatelskikh Zadatch): A Case Study (Product Hanger)

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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ABSTRAK

Kajian ini adalah mengenai ciri-ciri rekabentuk produk berdasarkan keperluan pelanggan menggunakan kaedah proses 'Kansei Words', 'Conjoint Analysis', 'TOPSIS', dan 'TRIZ'. kajian ini dijalankan untuk mengenal pasti dan menyiasat ciri-ciri produk yang diperlukan oleh pelanggan. Kajian ini mengandungi "preliminary test survey, post test, main survey" melalui bentuk-bentuk pertanyaan yang diberi kepada 500 pelajar di Universiti Teknikal Malaysia Melaka sebagai responden terhadap produk penyangkut baju. Melalui motivasi apabila mereka membeli produk dan kadar relevan dan keperluan teknikal untuk produk ini. Selain itu, emosi dan perspektif efektif oleh rekabentuk produk, kajian ini menggunakan "SPSS software" untuk analisis data statistikal dan "Conjoint Analysis" untuk melahirkan gabungan terhadap keperluan ciri produk dan taburannya. Hasil dari kajian menunjukkan rekabentuk produk berdasarkan harga, ketahanan dan diperbuat daripada bahan plastik. Melalui rekabentuk emosi,(perbezaan semantik oleh "Kansei Words" terhadap 10 rekabentuk penyangkut baju), pelanggan menggunakan 'Simple' (SI) sebagai luahan yang selalunya diolah didalam Rekabentuk-1, Rekabentuk 5, dan rekabentuk 6 menggunakan kaedah "TOPSIS". Pelanggan lebih suka menggunakan rekabentuk dari segi ciri--ciri teknikal (Plastik, ketahanan, kepanjangan, Lebar, Penggunaan yang mudah), dan menggunakan pendekatan "TRIZ" untuk menyelesaikan kesatuan untuk membaik pulih pembuatan. seperti "Dynamic". Later belakang ini, mempunyai 6 cadangan rekabentuk melalui prototaip produk yang diperbuat daripada "post test survey" kepada pelanggan. Ini menunjukkan mekanisma seperti produk penyangkut baju boleh dilipat ataupun boleh 'Extended-Retractable' khususnya jika produk bahan adalah plastik dan rod "Flat". Di dalam prototaip penyangkut baju, pelanggan tidak dikhususkan sebagai "Simple" tetapi juga "Stylish" dan "Modern"(Rekabentuk 8) sebagai "Rank-1", manakala "Rank-2".(Rekabentuk 9) adalah "Modern"

ABSTRACT

This project discussed about the design properties of product based on the customer needs using Kansei Words method, Conjoint Analysis, TOPSIS, and TRIZ. To identify, investigate, and determine what the characteristics of products required by customer, this project conducted the preliminary test survey, post test, main survey through the developed questionnaires to 500 varsity students in Universiti Teknikal Malaysia Melaka as respondents towards hanger products as a case study. Based on what their motivation when they buy a product and what the relevant attributes to their preferences as well as the technical requirements of a product, beside the emotional or affective perspective of the product design, this project employ SPSS software for statistical data analysis and Conjoint Analysis to perform the combination of requirements against the product characteristics and attributes. The result of main survey shows that the preference of product design is related to price, durable, and made by plastic material. While towards the emotional design perspective (as it is articulated through semantic differential towards Kansei words towards 10 hanger design), the customer articulate 'Simple' (SI) as their expression which mostly represented in Design-1, Design-5, and Design-6 based on the TOPSIS method. Since the customer prefer the design of products that are actually contradiction among their technical characteristics (such Plastic, Durable, Length, Width, Ease to Use), then the using of TRIZ approach is required to solve these contradictions for improving made, that is in 'Dynamic'. This is a background of the 6 new proposed design through the prototype of products made in which through the post test survey to the customers shows more to likely preferred since the mechanism of these hanger products are 'can be Folded' or 'Extended-Retractable', especially if the material of product is plastic and the frame rod is 'Flat'. In these new hanger product prototypes, the customers are not only articulate it as 'Simple', but also 'Stylish' , and 'Modern' (Design 8) as Rank-1 , while for Rank-2; Design 9 is 'Modern'.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

KE	-	Kansei Engineering
TRIZ	-	Theory of Inventive Problem Solving
CA	-	Conjoint Analysis
CS	-	Customer Satisfaction
SD	-	Semantic Differential
VOC	-	Voice of Customer
KW	-	Kansei Words
CR	-	Customer Requirement
DR	-	Design Requirement
TC	-	Technical Characteristic
TOPSIS	-	Technique For Order Preferences By Similarity to Ideal Solution

CHAPTER 1

INTRODUCTION

1.1 Project Background

Nowadays, the advancement of successful new products delivered in the hyper competitive market is as main objective of the ‘consumers’ goods’ manufacturing companies.

triggers many different ways developed by company to consider user requirements during the product development process. In addition, this condition led to shortening development time of new products with combination an increased focus on cost reduction since the life cycles of products are shorter than before (Brown & Eisenhardt, manufacturer will, typically, involve some level of consultation to construct their st.rategies (operational and management) in order to meet market needs since customers are ultimate judges of products (, most producers (manufacturers) are, in facts, not easy to make it real cause some of them were not usually straightforward.

First, this is due to the company see an opportunity for a new pro.duct that needs to be recog.nized by all of their organizations. Most of them thought that the ideas evoked from this opportunity (especially towards a new pro.duct development process), must to be designed, manufactured, and established. In this issue, the company’s frame.work (decomposes the path between the producer – business and design team- and the user) should illustrate that their designers understand how to

manipulate product characteristics to enhance positive perceptions (Crilly *et al.*, 2004). The question for the company is, however, not only on how they do this quickly, cheaply, and

the gap between what are customers, actually, expecting agai.nst what manufacturer can provide. Risdiyono and Koomsap (2013) emphasized that when the gap between customer requirements and product specifications are kept as small as possible, t.hen the companies are expected to let customers involve in value creation so that they get what exactly they want without compromising any requirements.

Previously, Ackoff (1981:66) stated that one route to success for the company is how they interact with the user in the design process in order to identify new product opportunities and to estimate candidate designs. This is due to, for instance, too often designers

(product) development and human interaction with the technology rather than problem solving or design of new processes (Kensing & Blomberg, 1998). This phenomenon occ.urs because many decisions, apparently focused upon purely technical issues are in fact socio-technical in nature (Damodaran, 1996:363). □ħ□□≻∘□□ □ö□↦□←∘□ ↦□□ □↦□□↕ä↕□ ◡‾□□□◠ ←□□□←□□ □ħ□ ↕∘∓≺↦□□ □∘ ≻□ □□ ↦□□ ↦↕□□□□ □□← □↦□← □∘ ←□↦□↕ħ □ħ□ solutions through new methods, new project roles, and other ways in planning and allocating resources for a project etc. This is beca.use of when they engage with users in order to consider how their product should fun.ction, they will produce the prod.ucts that could be satisfactorily performs to the required functions. In this perspective, the real problem is due to the forms of design for customer – where products and services are generated by developing product descriptions or into pro.duct availability – unable to give ideal satisfaction to all customers. "*Making products that work well and fulfill user expectations is not enough*" (Almagro & Llabrés, 2011).

Moreover, as a form of competitive, Xie and Tu (2006) saw this condition make customer for the demand of better responsiveness. Also, at the same time

forced manufacturers to change their mindset to be more active on understanding for satisfying their customers. The reason is some customers still require the improvement made in terms of requirements of the prede.fined product in the variety, in which the technology development has established a reasonable market led to the modification of product advancement fundamental from the manufacturer-oriented to customer-oriented. Even though, most rec.ent products made that has relatively considering about attributes of ergonomic and functionalities. This is means that, by now, the design of manufacturer in the early step of product develop.ment has been replaced by design for

the design efforts towards the developing products which will satisfy the consumers' needs. To enhance the likelihood of success of a product when launched onto the market, they added that the companies are , therefore, essential to assess the attractiveness of its product form during the design stage, beside to [illegible] & Carl, 2005; Jiao *et al*., 2006).

Second, based on terminology of a product itself (it is related to the availability of the product that is best match with the customer needed), the important thing towards customer satisfaction is how to of consumers to the products based on users' assessments and their psychological and behavioral feedback. Indeed, many see it as a critical success factor for new products. However, user

success rates for new products. The reason is due to company less clear on how to evaluate the more on emotional or affective perceptions of a product/pack offering. Whereas, the design of products which attract on an affective or emotional level should have value that can always successfully

covers the collation of user-driven features, in which a great deal of subjective interpretation to allow the specialist to translate the outcomes into real design features. Therefore, by working closely with the end user to gather data and/or inspiration is , however, necessary to ensure that users feel affinity with the final product. This is means that 'the [illegible]' [illegible] a product is on how to improve the customer satisfaction and reduces a risk of miss interpreting customer need. Even though, to obtain high customer satisfaction from individuals are, in facts, different and make it as

life and they want to have an enjoyable and satisfied life" ( ).

Hence, related to problem aforementioned above in terms of the successful of a new product, Shen *et al*., (2000) underli.ned about how to capture the "voice of the customer" related to the customer's preferences into the product's form elements. Naeni and Hedid.a.ripour (2011) discussed about the respon.ding trends to customer needs approaches to make an appropriated

orientation in considering emotional and cognitive aspects of human, beside the fulfillment of safety requirements and micro-ergon.omics. In this perspective, experience is one of important element in design principle where learning process as transformation process from experience to knowledge (Perang.inangin *et al.*, 2009). This approach derives from a strong believe that customers know best about their needs and constraints (Risdiyono & Koomsap,

) stated that someone purchase a passenger car due to the images in their mind may be "a powerful

engine", "easy operation", "beautiful and

as an articulation that the consumers really want to have such kind of a vehicle if the manufacturer succeeds in realizing a vehicle fitting to their imaginations. This is means that the most important aspects within this story is how the company to place and stresses 'their message' on our senses, consciousness, and feeling (Shiizuka, 2007).*"The emotional aspects attached to products cannot be*

used is as the total concept of senses, consciousness, and feelings that related to human behavior in social living.

1.2 Problem Statements

According to Sanabaria *et* are several concepts in the industrial process that may affect the information for planning, evaluating or innovating in product conception which is to satisfy the user expectations as one of the company's objectives. Specifically, Nagamachi (2008) discuss on product development application that implies the technology provided and design specifications

, design and engineering, and the final product (Sanabaria *et al*., 2003) .

As instance to residential property, Im.an *et al*., (2012) revealed the factors such as location, price, property type, built-up area, smart-home features, and developer reputation that make up a substantial portion of the preferences expressed by buyers in residential property purchase decisions. While to online consumer satisfaction, Schaupp and (2005) indicated the three most important attributes to consumers are privacy (technology factor), merchand.ising (product

factor), and convenience (shopping factor). These are followed by trust, delivery, usability, product customization, product

) related to the existing and new brand of aerosol products. Even, Hung and Cheng (2009) in his report gave an example about retro cars that e nostalgia on customer memory by borrowing the characteristics of classical cars, but actually, at the same time it spark of the moderness perception.

In the process, these attributes can be analyzed to reveal trade-offs between some of the selected attribute levels in order to determine the elements that can be given up to obtain other elements that cannot be given up as easily. This is done to ensure the maximum attainment of personal utility from a particular purchase decision. Therefore, the

on what of most companies delivered their products with more functions or features to the markets, Han *et al.,* (2000) argued that such strategy usually results in a more complex user interface and thus makes the product neither convenient nor easy to use.

First, based on human perspectives towards state of psychology and emotion, Janlert and Stolt.erman (1997) whose discussed about the human character (as combination of several characteristics related to integration of a relatively coherent of the contents of each expression mode), argued that many

each expression mode to the styling task in defining completely the character of the imagined cars. On this perspective, (2000) underlined the approach of an evolutionary cognitive perspective. They said that one cannot sensibly talk about emotion affecting cognition because cognition refers to a language for

, the generative capability of a shape grammar based design system should be enhanced to allow designers experiment with the evolutionary designs. Consequently, the instincts of the individual designers should be developed and enhanced on the affective aspects of a product's form (Chang et al., 2006). Based on

with different customer inputs such as "what they think / feel," in hierarchical relationships with companies will hide the problems or as blockers.

Second, this phenomenon affects to the consumer's decision-making process regarding the choice the different products. In their research related to the customer choices about the network operators, specifically Turn.bull *et al.*, (2010) confi.rmed about the importance of word-of-mouth and brand i.mage as risk reduction strategies in the market by look.ing at information to the ma.rket and customer behavior with the ranking of different information. Although, this seems rather obvious for the way of understanding a product

). Therefore, the main concern on products are on how they have to be innovative and attractive to the customer since the products with a lack of innovativeness as well as products with too many new features are likely to fail (Schüt.te *et al.,* 2008). In addition, by understanding the needs and preferences of consumers as the key to success (whether the objective is to design a new product and/or to mo.dify and evaluate an existing one), Charles *et al.,* (2011) stated that the compa.ny needs to differentiate from others by adding value, especially when the number of choices increases for consumers. They emphasized that the company

exhibit more qualities in their products. Logically, most manufacturers, therefore, use the customer re.search instruments in order to find out what feat.ures to include in new product generation and how the pot.ential customer group feels about those alte.rations. Here, [illegible] data entry tasks. Also, she added that the informed user involved in such a dec.ision is thus in a position to influence highly significant aspects of working life. In reality, for user influence to be real with any affective, however, requires a great many preconditions and requirements to be met due to by empowering the user will very demanding and complex. In addition, there are difficulties in incorporating the user-centered and this is to be mainly a question of moving the development

an individual, in most situations, however, the individuals cannot really test the product performance in order to understand its true functions.

Third, to achieve impro.vements is not only in product flexibility, but also in some other issues in comparison with current strategies (Risdi.yono & Koomsap, 2013). Even though the strategy about m.ore functions or features to the markets (based on customer expectations) are often important and often wrong, how.ever in the eyes of producer (company), they are all .important because people's actions on their implicit and explicit predictions of the emotional consequences of future events. In facts,

range needs. He underlined about the most important advantage through the interaction between the needs of the customer elements and design elements with a systematic approach in the explanatory analysis to identify customer needs elements or sets of design elements. For examples, a

forms of consumer preferences to a product by evaluating its attributes based on cognitive and rational terms (

of related product design attributes (Bahn & Lee, 2009), motivations (Krippendorff, 2004), etc.

However, according t.o Chang *et al*., (2005), since most o.f consumers had lack the necessary skills to describe their desire formed in clearly and comprehensively, the developers comm..only face difficulties in truly understanding the preferred product form. According to Hsiao and Ch.en (1997), one the back.ground is due to the psychological prob.lem ≻∘⇳_→□□ ∘□ →ħ□ □∓↦□□ ≺□_→⇳□≺_→□∘□_← ∘_→ ∓□□_→↦ℓ ≻□□ℓ□□□_← ≻∘_→ ↦ ≺_→∘□_⇳_→ ↦_→□ ≻_ℓℓ ∘≻ ≻_□□□□□□_→ ↦□□ _□⇳□_→↦□□_→□□_□ ⋂□ ↦□□□_→□∘□□ _□□⇳□ ∓∘_→ ∘≻ _□∓□ℓ ↦_→ ≺_→∘□_⇳_→ ↦_→□□ □∘_↦□↦□_← ∓↦□_≻↦⇳_→□□ _□_→ħ similar utility, then it makes the company difficult to compete just on the basis of cognitive evaluation (Gan *et al*., 2010). Moreover, people may also fa.il to correct answer to their inferences about their initial reactions by taking into account the effects of the passage of ti.me (under correction) in which Gilb.ert (1998) said that the emotional consequences of failure (motivated distortion)

more directed to customer-oriented development. Specifically, according to Chang *et al*., (2006), towards the functions and utilities of the product which can be perceived by consumers as ‘‘apparent functional attraction’’, ‘‘semantic interpretation’’, and ‘‘apparent function’’.

Hence, this projects use the methods and tools of Kansei Engineering with semantic differential (SD) method that has been widely used in emotional product

by adding the objective attributes (Schütte *et al*., 2008). Specifically, through the approach of conjoint analysis and the multidimensional scaling tech.nique for identifying the multiple factors that simul.taneously affect the purchasing decision of consumers (Charles *et al*., 2011), where statistical methods (that are commonly used in KE) as principal component analysis (Almagro 2011).

1.3 Objectives of the project

This project discusses about an integration of affective engineering into the product development process using the Kansei Engineering (KE), TRIZ, and Conjoint Analysis based on the subjective perspective towards consumer product. In order to achieve the satisfaction levels, this is means the product designed need to be constructed and based on customers requirement. The objective of this project as follows:

a) To identify and determine the emotional feeling of product design related to customer satisfaction using Kansei Engineering (KE) with semantic differential (SD) scaling approach.
b) To analyze the design requirement of product design preferences using Conjoint Analysis.
c) To evaluate the customer satisfaction and preferences towards the design of product.
d) To develop and propose the prototype of new product design based on TRIZ approach.

1.4 Scope Of The Project

In this project, the approaches used to determine customer preferences and satisfaction is focused on the hanger product based on human kansei. The hanger product is one of the common product used for hanging clothes in order to prevent wrinkling of shirts with wet or dry condition and in various places. To create a hanger design that matches to customer requirements, the manufacturer should therefore determine first what is customer preferences based on functional, features,