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SUSTAINABLE DESIGN CONCEPT EVALUATION (SDCE)

MUHAMAD AIMAN BIN MAHMUD

Report submitted in partial fulfillment of the requirements
for the award of the degree of
Bachelor of Engineering in Mechatronic Engineering

Faculty of Manufacturing Engineering
UNIVERSITI MALAYSIA PAHANG

June 2016

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this project and in my opinion, this project is adequate in terms of scope and quality for the award of the degree of Bachelor of Mechatronic Engineering.

Signature :

Name of supervisor : Ir. Dr. FAIZ BIN MOHD TURAN

Position : LECTURER

FACULTY OF MANUFACTURING ENGINEERING

UNIVERSITY MALAYSIA PAHANG

Date :

STUDENT'S DECLARATION

I hereby declare that the work in this project is my own except for quotation and summaries which have been duly acknowledged. The project has not been accepted for any degree and is not concurrently submitted for award of other degree.

Signature :

Name : MUHAMAD AIMAN BIN MAHMUD

ID Number : FB12063

Date :

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LIST OF SYMBOLS

On	alternative
Cm	criteria
fi+	the best rating
fi-	the worst rating
A	the decision matrix
A^+	the positive ideal solution
A^-	the negative ideal solution
di^+	Euclidean distances
$\mathcal{E}i$	the relative closeness
R	abbreviation of respondents
K	number of group respondent
$\otimes v_{ij}$	the grey number value attribute
S*	The lower close guess of good other choices
aj	conditional attributes
sj	number of design
vi	the rating value of evaluation criteria from respondents survey results
i	refers to alternatives
j	refers to different attributes

LIST OF ABBREVIATIONS

SD	Sustainable Development
CE	Concept Evaluation
R&D	Research and development
Es	economy, ecology, equity
IUCN	International Union for the Conservation of Nature
MA	Morphological Analysis
AHP	Analytical Hierarchy Process
ANP	Analytic Network Process
TOPSIS	Technique for Order Preference by Similarity to Ideal Solution
FRF	Frequency response function
DI	Departure index
DC	Difference coefficient
3P	Profit, people and planet
GRC	Grey relational coefficient
GRG	Grey relational grade
5P	Profit, people, planet, process, and product

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ABSTRACT

The unreliability in the market today and demanding of electronic product by customers makes companies and decision makers to find cost effective and time efficient to improved product development process. As we know, design concept evaluation is a critical part in product development and it is the end of conceptual design. It is related to the final success of product development, because when poor criteria assessment in design concept evaluation can be harm at the later stages. Besides that, the companies start to concerned about the sustainability element which is planet, profit and people. This situation give pressure to R&D engineer to make decision in design concept evaluation and to incorporate sustainability to design product. The objective is to provide an alternative method for aiding a group of a decision makers to effectively decide and evaluate the best choice among a set of alternatives under fuzzy conditions. Another objective is to implement sustainability elements in design concept evaluation. In this project, the method is first work that uses an integrated approach of scale of "Weighting Criteria" and decision-making tools which is modified Rough-Grey Analysis. This project also incorporates with sustainability element that can call it as 3P (profit, people, and planet) in assessing the criteria. The inputs are from voices of customers converted to design criteria and survey using scale of weighting criteria. Quantify and normalize are used in dummy attributes tables and procedures of modified rough-grey. Mapping is used when to incorporate sustainability element and the data is from final value of normalize rough-grey analysis. The benefit is enables the designers to make a better-informed decision which incorporated with sustainability assessment result before finalizing the best design concept. The results can be concluded as the system can help a group of decision makers like R&D engineer to improve the effectiveness, objectivity and sustainability of the design concept evaluation. The system can help both private and government which associated with decision-making process.

ABSTRAK

Ketidakcekapan dalam pasaran hari ini dan menuntut produk elektronik oleh pelanggan menjadikan syarikat-syarikat dan pembuat keputusan untuk mencari kos yang berkesan dan masa yang cekap untuk proses pembangunan produk menjadi bertambah baik. Seperti yang kita tahu, penilaian konsep reka bentuk adalah satu bahagian penting dalam pembangunan produk dan ia adalah langkah terakhir dalam reka bentuk konsep. Ia adalah berkaitan dengan kejayaan akhir pembangunan produk, kerana apabila penilaian kriteria menjadi lemah dalam reka bentuk penilaian konsep, ianya boleh mendatangkan bahaya pada peringkat kemudian. Selain itu, syarikat-syarikat mula mengambil berat berkenaan elemen kelestarian yang merupakan planet, keuntungan dan rakyat. Keadaan ini memberi tekanan untuk R&D jurutera untuk membuat keputusan dalam penilaian konsep reka bentuk dan memasukkan kemampanan dalam mereka bentuk produk. Objektifnya adalah untuk menyediakan kaedah alternatif untuk membantu kumpulan yang pembuat keputusan untuk membuat keputusan dan menilai pilihan yang terbaik di antara satu set alternatif di bawah keadaan kabur berkesan. Satu lagi objektif adalah untuk melaksanakan elemen kelestarian dalam penilaian konsep reka bentuk. Dalam projek ini, kaedah ini adalah hasil kerja pertama yang menggunakan pendekatan bersepadu skala "Kriteria pemberat" dan alat membuat keputusan yang diubahsuai Rough-Grey Analisis. Projek ini juga menggabungkan dengan unsur kelestarian yang boleh memanggilnya sebagai 3P (keuntungan, orang, dan planet) dalam menilai kriteria. Inputnya adalah dari suara-suara pelanggan ditukar menjadi reka bentuk kriteria dan dikaji selidik menggunakan skala kriteria pemberat. Mengukur dan menormalkan digunakan dalam dummy sifat-sifat jadual dan prosedur yang diubahsuai kasar-kelabu. Pemetaan digunakan apabila untuk menggabungkan elemen kelestarian dan data adalah daripada nilai akhir analisis menormalkan kasar-kelabu. Manfaat ini membolehkan pereka untuk membuat keputusan yang lebih bermaklumat yang digabungkan dengan keputusan penilaian kemampanan sebelum memuktamadkan konsep reka bentuk yang terbaik. Kesimpulannya, kaedah ini adalah sistem yang boleh membantu sekumpulan pembuat keputusan seperti jurutera R&D untuk meningkatkan keberkesanan, objektiviti dan kemampanan penilaian konsep reka bentuk. Sistem ini boleh membantu kedua-dua sektor kerajaan dan swasta yang berkaitan dengan proses membuat keputusan.

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF RESEARCH

In this chapter will discuss about the introduction or project background, the problem statement, the objectives, and the scope of the project. The project title is about a model of sustainable design concept evaluation.

1.1.1 Sustainable Development Vs Concept Evaluation

Helping the planet development or Sustainable Development (SD) show encouraging money-based growth together with protection of the surrounding conditions quality, each strengthening the other. Sustainable development also maintaining a balance between human purposes to improved way of living and feeling of richness on the one hand, and maintaining the valuable things from nature and communities on which our future generation and we are also depending on it. The sustainable development also can be defined as to improve the quality of life while living within the carrying ability to hold or do something of communities (IUCN, The World Conservation Union, 1991).

Therefore, sustainable development does not focus only on related to surrounding conditions or the health of the Earth issues. More importantly, it makes up three parts, namely general policies of money-based, related to surrounding conditions or the health of the earth and community. For the Swiss 'Monitoring of Sustainable Development Project' MONET (BFS, BUWAL & ARE) in 2001, proposed the following definition: 'Sustainable development means to make sure of serious and self-respecting facts or conditions that surround life connected to human the right to be equal and maintain the wildest possible range of options to choose design life. The way of thinking state where all things are equal between and among the present and people who will live in the future need to be thought about in the use of both clean air and water, good crops, etc., money-based and social. Placing these needs into practice will require complete and thorough coverage of bio-diversity or many different kinds of people or things in community, species and genetic diversity or related to tiny chemical assembly instructions inside of living things, all of which a key basic life (MONET, 2001).

Due to advances in technology, well-developed in the world today, there are major changes in the market for commercial messages. New products must be developed by many company due to the flow of retail stores, primarily in technology-ride or hi-tech market. Therefore, to choose the best among all the products, methods or tools for decision-making is important. Organizations are challenged to produce tools that can make a variety of decisions for each product because it can be the good judge to choose the best product. In develop or create a new product most important stage is the design stage. The design stage is broken into two part, which is many judging requirements and sub-judging requirements. It is also referred as a "Design for" based on customer demands and available technology. The important part in the design stage is weighing which judging requirements are of most importance to the customer. In a perfect world, to satisfied the customer needs, the product can be design, but it can be overly priced product. If the product price is not concerned by the user, the product will have chance to be marketable. Unless the people who use the product or service are concerned with the products' price, the product will have no chance to be marketable.

Wang *et al*., (2002) in order to understand the needs for conceptual design engineering and to clear up the current conceptual design practice, studying the domain of group or working well together conceptual design based in technologies is needed. Kurakawa (2004) the viewpoint of the designer's thinking is good to proposed a model. Based on situation-driven conceptual design information which is a basic part of practical design support tools, the model was developed. Chong *et al*., (2009) proposed an experience-based thinking method for uses on conceptual design in order to guide designers in the act of asking questions and trying to find the truth about something of design concepts problems. Kim & Xirouchakis (2010) proposed a decision support system for the design concept filtering and selection stages. Avigad *et al*., (2011) developed a fuzzy math based or computer based tool based on supply chain that helps designers in selecting an engineering concept. Nagel *et al*., (2011) reported a functional modeling for product design where customer needs are translated into a representation of elementary operations defining a desired goal. Now, they want to linked the sustainability assessment method with the design concept evaluation which is decision-making tools.

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