COMPARATIVE EVALUATION OF EXISTING PRODUCT FOR ECO-DESIGN

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SUPERVISOR DECLARATION

"I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Design and Innovation)"

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This thesis is submitted as

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DECLARATION

"I hereby declare that the work in this thesis is my own except for summaries and quotations which have been duly acknowledged."

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Date : ……...

I dedicated this project to my beloved family especially my parent for all the support that has been given to me in doing this thesis.

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ABSTRACT

Eco design product is an environmental concern products. The characteristics of eco design in the products can be seen in all phases of the product. From the production phase to the disposal phase of the product. The problem is the user and manufacturer did not know how does a product can be categorize as eco product. Eco designed product will give a lot of benefit to the user and also the company that make the product. What they need is a tool to identify whether the products that they interested can be considered eco designed or not. This report is to demonstrate a method to shows why does a product can be categorize as eco design if compared to other product. The tool which been used was Quality Function Deployment for Environment or QFDE. In using this method, two products of the same function will be chosen. Then, a comparison will be made in the form of QFDE and the results will display which product show stronger behaviour toward eco design. A suggestion for a better design of the product has been made after the analysis of the QFDE method. By having this method, a product's manufacturing company can analysed their current product to make changes for more eco designed product. By the end of this project, the eco related properties of a product had been identified and the demonstration of using the QFDE method had been shown.

ABSTRAK

Produk reka bentuk Eco adalah produk berteraskan alam sekitar. Ciri-ciri reka bentuk eko dalam produk dapat dilihat dalam semua fasa produk. Dari fasa pengeluaran untuk fasa pelupusan produk. Masalahnya ialah pengguna dan pengeluar tidak tahu bagaimana sesebuah produk itu boleh dikategorikan sebagai produk eko. Produk eko yang direka akan memberi banyak manfaat kepada pengguna dan juga syarikat yang membuat produk. Apa yang mereka perlukan adalah alat untuk mengenal pasti sama ada produk yang mereka berminat boleh dianggap eko atau tidak. Laporan ini adalah untuk menunjukkan satu kaedah untuk menunjukkan bagaimana sesebuah produk itu boleh dikategorikan sebagai reka bentuk eko jika dibandingkan dengan produk lain. Alat yang digunakan adalah "Quality Function Deployment" atau QFDE. Dalam menggunakan kaedah ini, dua produk dengan fungsi yang sama akan dipilih. Kemudian, perbandingan akan dibuat dalam bentuk QFDE dan keputusan akan memaparkan produk yang menunjukkan tingkah laku yang lebih kukuh ke arah reka bentuk eko. Cadangan untuk reka bentuk yang lebih baik daripada produk itu dibuat selepas analisis kaedah QFDE itu. Dengan adanya kaedah ini, syarikat pembuatan produk boleh menganalisis produk semasa mereka membuat perubahan untuk mereka produk yang lebih eko. Pada akhir projek ini, sifat-sifat eko berkaitan produk yang telah dikenal pasti dan demonstrasi menggunakan kaedah QFDE telah ditunjukkan.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOL

QFDE	=	Quality Function Deployment for Environment
EOL	=	End of Life
QFD	=	Quality Function Deployment
HOQ	=	House of Quality

CHAPTER 1

INTRODUCTION

1.1 RESEARCH BACKGROUND

Nowadays, manufacturers need to struggle in order to decrease the environmental effect cause by their products while they compete in their markets. The environmental qualities that need to be incorporate in the designs such as to save the environment from global warming, to reduce the energy consumption by the products, or to lower the risk of health problem that may cause by the product such as asthma if the product produce smoke residue. In order to press on this matter effectively environmental consciousness must be taken into account during their design activities and this kind of activities is called Eco design or environmentally conscious design (Sakao 2007).

For the energy-related products, their eco design characteristics are mainly to reduce the energy consumption. This will help the user to experience products without worrying the cost they might need to overcome after sing the energy-based product. The type of energy source had also been the different characteristics for these eco energy-based products. Energy cannot be destroyed but only can be

converted into another different form of energy. By applying this concept, designers of the products make the energy source needed to make the product works can be easily obtain thus, making the cost for energy consumptions is cheaper.

Some of products may have given the user difficulties in the aspect of their health. For examples, a normal chair design may have cause backbone pain to the user or a normal LCD screen without the tinted layer might have cause the user to suffer from cataracts or other eye related disease.

The environment concerned products are one of the most important things in creating an eco product. Some product emit residue such as smoke. In the smoke, there were a lot of chemical component that can cause bad health problem to the user. In the eco design product that been design to overcome this kind of problems were usually been recognize by a lot of environmental organization. By having this recognition and certificates, the trustworthy of the product by the user had also increase as people nowadays is very concern about the environment.

1.2 PROBLEM STATEMENT

Users nowadays have not taken eco product seriously in their daily activities. This may due to the unexposed benefit that they can gain by using an eco-product in their daily life. When they buy a product, there is no sure way for them to know whether the product that had been bought is eco or not. User should know how strong the eco characteristics of the product that they owns. The problem is, there is no method for them to indicate whether their product is eco design or not. This method need to clarify whether a new design product is eco designed compared to old existing product.

1.3 OBJECTIVE

The objective of doing this research is to:

- Identify the eco related properties in a product that make it an eco design and study the consequences to the product's assembly parts.
- Demonstrate the usage of QFD method in analyzing two products.

1.4 SCOPE

The scope of this research is to suggest the design changes on a product to reduce the environmental impact. What will be done is select a benchmarking product which is the original functional properties product and a same functional product but may have different in the parts characteristics. Then, a list of functional characteristics, parts function and environmental requirements will be made. Comparison of both products and mapping based on the list will also be made. Both products will undergo teardown process in order to do the mapping. With the data collected, Quality Function Deployment for Environment (QFDE) method will be applied.

The step of implementing QFDE will be a part of this research. The flow of implementing QFDE will also be the important part in this research.

1.5 REPORT OUTLINE

Chapter 1

- Will introduce the main objective and scope of the report.
- Brief about the problem statement that will be solve by the end of this project report.

Chapter 2

- Will be the literature review about every related title to this project.
- Every related title will be explained based on previous research.

Chapter 3

- Will be the methodology that will be used to achieve the objective of this project.
- A flow of methodology will be created in order to display the flow to get the result of this project.

1.6 SUMMARY

As summary, this chapter had already briefly explaining about the importance of eco-design product in human or user daily life. The use of environmental friendly product is one of the step that can be taken by people nowadays in order to save the environment. However, the problem is the user does not know how to differentiate which product contribute the most towards eco-design. The step of comparing products for which contribute the most to environment which is Quality Function Deployment (QFD) will be develop and further information and discussion will be meet in the consequent every chapter.

CHAPTER 2

LITERATURE REVIEW

2.1 OVERVIEW

In this chapter, the content will only focuses on the concept of eco-design product, the environmental concern when designing a product and the types of characteristics that makes the product an eco-designed product. In designing an environmental concern product, the environmental issues will correlate with the characteristics of the product and thus will fulfil the concept of eco-design product. The overall concept will be discussed in this chapter.

2.1 DEFINITION OF ECO-DESIGN

Eco-design is known by various other names such as Green design, design for environment, sustainable design, environmentally conscious design, life cycle design, life cycle engineering or clean design. This process happened early in the product's life cycle design or in the upgrade phase as to ensure that the environmental consequences of the product's life cycle are understood before

manufacturing decision are committed. In order to improve the design of the product from an environmental perspective, researchers have analyzed various stages of the product's life cycle and developed methodologies to improve the design of the product. Consequently, eco-design was broken down into many stages including product's manufacturing, use and end-of-life (EOL). The role of eco-design according to Gheorghe and Ishii (Gheorghe and Ishii 2007), is as shown in figure 1.

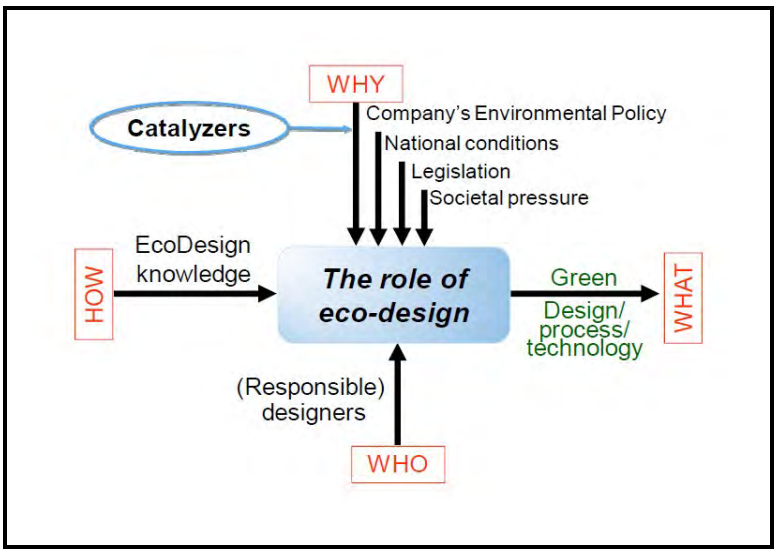

Figure 2.1 the role of eco-design (Gheorghe and Ishii 2007).

When comes to eco-design, the relation towards the environment is very strong. The concept of eco-design often referred to as cleaner production or design for the environment, describes a design process which takes into consideration the environmental implications of a designed product or process by using various approaches (Ben-gal and others 2006). This shows that design made to avoid undesirable or may become hazardous effects toward the environment.

In fact, the environmental issue has become one of the critical ones for manufacturers. They are required to decrease environmental impacts caused by their products while they compete in their markets. From quality viewpoints, "environmental qualities" such as the global warming potential and the rate of recyclable materials that had not been traditionally tackled on must be incorporated. In order to address this effectively, environmental consciousness must be taken into account during their design activities. This activity is called Ecodesign (environmentally conscious design), which is defined in Sakao's (Sakao 2007)

research paper as “design activity reducing the environmental impacts throughout the life cycle of a product to be designed”. Note that the target “product” does not include a service but refer to a physical product. In addition, Sakao’s paper addresses improving design, namely redesign, not new product design.

The increasing requirement of environment protection leading to the eco-design of a product. To identify the environmental aspect and connect it with the product during the design process is the early stage of the product development. Eco-design also defines as design for environment (dfe) and design according to the sustainable development principles. Ecodesign introduces additional dimension to the original design but still, the importance aspect such as function, safety, ergonomic, endurance, quality and cost plays the important changes. These additional criterion changes is the project estimation from attention on its environment influence (Nowosielski and others 2007).

When it comes to Ecodesign, European Union (EU) have their own Ecodesign Directive that act as tools in order for them to deliver cost-effective energy savings. For them, the definition of ecodesign is the aim of reducing the environmental impact of a number of product sold in the EU, with the emphasis on their energy consumption. This shows that the crucial aspect in having ecodesign in EU term is the electricity and heat consumption or to be precise, the ability of products to have energy efficiency and other environmental requirement for each product group (Molenbroek and others 2012).

Ecodesign is also known as one instrument that contributes to the attainment of that goal by contributing knowledge of how develop innovative products and integrated solutions while taking environmental considerations into account. As according to Olundh (Olundh 2006), “Company’s leader will have to accept that being green means that they will not always be able to make the most economical choice.” This shows that environmental concern is very connected to a person personal belief, which is difficult to influence by others.

Improved product design which applies sustainability criteria or design for sustainability (D4S) is one of the most useful instruments available to enterprises and governments to deal with these concerns. For Crul and Diehl (Crul and Diehl 2007),

D4S includes the more limited concept of Ecodesign or Design for the Environment. In many developed economies D4S is closely linked to wider concepts such as sustainable product-service systems, systems innovations and other life cycle based efforts. In developing economies a lack of awareness remains a stumbling block. A broad definition of D4S would be that industries take environmental and social concerns as a key element in their long-term product innovation strategy. This implies that companies incorporate environmental and social factors into product development throughout the life cycle of the product, throughout the supply chain, and with respect to their socio-economic surroundings.

Environmental issues aspect being implemented in designing new product especially from the 90's. The term usually referred to those are eco-design or design for environment. According to Puglieri and others (Puglieri and others 2011) eco-design can be define as product development that incorporates environmental concern considering environmental requirement that allow reducing environmental impacts in product life cycle. So, throughout the life cycle of product, starting from the productions state to the disposal state, the impacts of the product towards the environment need to be considered.

European Network of Ecodesign Centres (ENEC), have their own definition of eco-design. For them, there are common characteristics of eco-design definition which are environmental impact reduction, life cycle thinking and taking a product design focus. They had stated that traditionally, ecodesign has been seen as applicable to products (including packaging), whereas more recently its field of application has broadened to include services and system. ENEC had also distinguish between visionary eco-design and operational eco-design has been shown in figure 2 and figure 3 (Prendeville and others 2012). Visionary eco-design is the starting process which required the individual critical thinking based on the surrounding current requirement with taken into account about the business matter. While operational eco-design is the planning of more detailed movement of product development flow with much more constrain and system planning.