NATIONAL TECHNICAL UNIVERSITY COLLEGE OF MALAYSIA

Design For Environment In The Electronic Industry

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By

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APPROVAL

This thesis summitted to the senate of KUTKM and has been accepted as fulfillment of the requirement for the degree of Bachelor of Engineering (Honours) Manufacturing (Process). The members of the supervisory committee are as follows:

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ABSTRACT

Design For Environment (DFE) is one of the systematic consideration that need to use in production for a certain product. The implementation of DFE will ensure the environment in secure and always under control at the end of the life cycle of the product. Many methods can be used in implementation the DFE in design of certain product. The methods of DFE are Design For Recyclabality (DFR), Design For Remanufacturing, Design For Disassembly (DFD), Design For Disposability, etc. The main method that usually used by manufacturer especially in manufacturing electronic component are DFD and DFR. DFD is more suitable for reassembly of Printed Circuit Board (PCB) because every electronic component using PCB. In additional, this method have many advantages compared to others method. Beside that, DFR is more suitable to use for the entire of electronic product such as TV, radio, refrigerator, washing machine, etc. From surveyed done in the electronic company (Sony), shows that the DFD and DFR method are mostly used in electronic component especially in PCB.

ABSTRAK

Rekabentuk Untuk Persekitaran (DFE) adalah satu pertimbangan sistematik yang teratur yang perlu dilaksanakan dalam penghasilan sesuatu produk. Ini kerana, perlaksanaaannya dapat memastikan keselamatan persekitaran dapat dikawal sepenuhnya diakhir kitaran sesuatu produk. Banyak kaedah boleh digunakan dalam perlaksanaan DFE ini dalam rekabentuk sesuatu produk. Antara kaedah tersebut ialah Rekabentuk untuk pengitaran semula (DFR), Rekabentuk untuk pembuatan semula, Rekabentuk untuk pemasangan semula (DFD), Rekabentuk untuk pelupusan dan sebagainya. Kaedah utama yang sering digunakan oleh pengeluar terutamanya pengeluar peralatan elektronik ialah DFD dan DFR. Ini kerana, DFD lebih sesuai dilaksanakan untuk pemasangan semula Printed Circuit Board (PCB) kerana setiap peralatan elektronik mempunyai PCB dan faedah yang banyak berbanding kaedah lain. Selain itu, DFR lebih sesuai untuk digunakan dalam komponen elektronik lain seperti yang terdapat pada peralatan seperti televisyen, radio, peti sejuk, mesin basuh dan sebagainya. Keputusan daripada kajian yang dijalankan di sebuah syarikat elektronik iaitu Sony mendapati kaedah DFD dan DFR memang dilaksanakan dalam komponen elektronik mereka.

DEDICATION

My Parents

Who has always been there for me and always prays of me,

My brother and younger sister,

My Friends

Who has support me.

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INTRODUCTION

1.1 Introduction of the project

Final year project is one of the projects where it is compulsory for all final year students in order to ensure they are qualified to get their degree and finish their education at Kolej Universiti Teknikal Kebangsaan Malaysia (KUTKM). This project is doing in two semesters which is final year project 1 and final year project 2.This project is appropriated 3 credit hours for every semester. In order to fulfill this condition, I choose Design for Environment (DFE) as my final year project.

In this project, I and my supervisor have been determined certain scope about the progress of this project. DFE is a widely project, so the clear guidance and scope is very important in order to ensure this project is going smooth. It is important for designer to implement DFE in certain design for certain product because the product might be able to give bad effect for environment at the end of life of the product.

Actually, we have another name are given by the designer or certain company for implementation DFE such as Life Cycle Assessment (LCA), Eco Design, End-of life Design, Green Product Design and Environment-friendly product. Although it have a different name, but it's still stay the same with it's objective, benefit and it's method. The main aim for implementation DFE is to

ensure our environment is under control from dangerous threat from poison which produces by the product.

A few methods can be used to ensure DFE can be implemented such as Design for Disassembly (DFD), Design for Recyclability (DFR), Design for Remanufacturing, Design for Disposability, and Design for Energy Efficiency. Each method contain different step and will give different result.

Beside that, another content of my project is to find a company in Malaysia where implement DFE in their product. So, I choose Sony Malaysia located at Bangi, Selangor as the chosen company for doing case study about this project. One of the important resources needed in this case study is the method used and the benefit of implementation DFE for the company. I also look for currently issues related with environment.

1.2 Objective of the project

The objectives of this project have to include the important aspects that content in this project. The objectives of this project as follows:

a) To understand the principle of DFE.
b) To know the suitable method used in implementation of DFE.
c) To gain the information about the issues of environment this related with DFE.
d) To find which company had implemented DFE in the case study.
e) To study the types of method used by the company and the way of implementation.
f) The benefit gained for the company by implemented DFE practice.

1.3 Scope of the study

In order to fulfill the objectives of this project, scope is important thing to determine the steps needed to run the project. This project were divided by 2 parts which follow the appropriate semester. For first semester, the scopes are about study and understand the concept of DFE. Furthermore, to understand about the method used in this project also apart of the first semester's scope. In addition, the environment issues and the selected company for doing the case study also be apart of first semester work.

For second semester, the scope is focus more on the implementation of the project. After selection the suitable company, the method used by the company and the information related to the DFE in selecting company was studied. Beside that, it is important to study about the benefit for the company after implemented DFE principle in designing the certain product.

1.3 Project planning

Project planning is important in order to ensure the project follow the plan arranged. In planning that has been made, the implementation of project is divided by 2 semesters. Each semester contains its own planning to ensure the result of all the activities run smoothly. Appendix A shows the activities of this project planning.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction Design For Environment (DFE)

Design for environment is a design to save the environment from hazardous pollution. Design for environment is also known as green engineering. This means cleaner air, less noise, a healthier environment and etc. the concept is practical enough to implement the eliminating one of the major sources of pollution will eliminate or reduce other associated problems.

Material management involves activities that lead to the recovery of materials or finished components for reuse in their highest value added environment benefits. Economic benefits results from reduced budgets for material, waste handling equipment and labor. Efficient material usage also results in other intangible benefits such as worker awareness and more accurate levels of material accounting.

In more general terms, waste reduction also involves products design for such things as extended durability, which is often considered a measure of product quality, and the use of less net material, since in many cases lightweight products are considered more desirable.

As we enter the twenty-first century, it seems that the twentieth century has left us with much waste to be eliminated. Scraps are serious problems which

are health hazards to human beings but if was dealt with properly, they can be both profitable and environmentally efficient. Environmental benefits can range from modest to sizeable reductions in waste volume, landfill capacity and transportation impact. These environment benefits can provide secondary economic benefits that are often overlooked in preliminary financial analysis.

2.1.1 Objectives of DFE

The objectives are to minimize or eliminate, during design, the anticipated waste generation and resource consumption in all subsequent life cycle phases: construction, operation, and closure (or production, use, and disposal).

Design for Environment primarily refers to product related environmental care, diminishing environmental effects of a product before it is produced, distributed and used. DFE examines the disassembly of products at the end-of-life and reveals the associated cost benefits and environmental impact of revision, reuse and recycling [1].

Design for the Environment (DFE) Programmer helps businesses incorporate environmental considerations into the design and redesign of products, processes, and technical and management systems.

2.1.2 DFE benefits

DFE offers businesses opportunity to improve environmental performance, while simultaneously improving their profits. Companies that implement DFE find that it [1]:

i. Reduces environmental impact of products/processes.
ii. Optimizes raw material consumption and energy use.
iii. Improves waste management/pollution prevention systems.
iv. Encourages good design and drives innovation.
v. Reduces costs.
vi. Meets user needs/wants by exceeding current expectations for price, performance and quality.
vii. Increases product marketability.

DFE can also provide a means for establishing a long-term strategic vision of a company's future products and operations. In general, DFE is an enabling force to shape more sustainable patterns of production and consumption

2.1.3 Design for Environment Guidelines

There are some basic fundamental guidelines in an environmentally design of product:

i. Keep the design by using as few materials as possible. Also, incorporate as many function as possible into any single part without compromising function. Avoid secondary finishes, toxic materials and heavy metals which can contaminate material.

ii. Find multiple or secondary uses for a product. Disposal will be less of a problem if a product has more "intrinsic value". As an example, a container protecting a product could also store the accessories the come with it.

iii. To ensure easier recycling, use materials that match each other closely or the same materials. Look for ways to use recycled materials as starting compounds for a product.

iv. Modular design should be preferred whenever possible. This helps in maintenance and repairs a "black box" concept.

v. Design for long product life and become more service-oriented. If a manufacturer upgrades its product as technologies improve, a more loyal customer base is assured.

vi. Ensure tracking mechanisms are available on a cradle-to-grave" basis. Ensure up-to-date databases are available. Ensure parts are marked with logos to aid in the recycling efforts.

vii. Examine those components in a design that may be reused upon failure or disassembly. This would reduce the need to recycle or dispose.

viii. Establish a network of procedures and suppliers to form the beginnings of the "industrial ecosystem" and facilitate design for environment (DFE) efforts.

ix. Look to reduce waste by-product streams in manufacturing processes. Seek out non-hazardous solvents and cleaning materials. Reduce energy consumption by eliminating unnecessary manufacturing steps.

x. Ensure a product "buy back" infrastructure is in place and well advertised to suppliers, producers and consumers.

xi. Pay close attention to recyclability and reuse of packaging, shipping and other peripheral requirements. Design reusable shipping vehicles.

xii. Whenever possible, attempt to incorporate a concurrent engineering philosophy: Just in time (JIT), Design for Manufacture and Assembly

(DFMA), Design for Disassembly (DFD), to aid the overall DFE effort. Design for total ease of assembly, separation, handling and cleaning.

xiii. Apply tight to tolerance design principles to reduce the use of fasteners and keep the separation process simple.

2.1.4 Levels of Design for Environment [2]

i. Level 1: Environmental improvement of existing products.

ii. Level 2: Radical redesign based on existing concepts.

iii. Level 3a: Green function innovation, for instance by application of a different physical principle.

iv. Level 3b: Green system innovation.

2.2 Principle of Design For Environment

2.2.1 Material Selection

Table 2.1: Guideline and Reason for material selection [17].

Guideline	Reason
Avoid or minimize use of hazardous, toxic or in any other way environmentally unfriendly materials	Decrease toxic and/or hazardous emissions in later life stages and/or decrease harmful emissions during production
Avoid materials with a high energy content (Aluminum)	Decrease the amount of energy used during extraction and/or production
Use materials which are renewable, recyclable and/or recycled, minimize use of thermo sets or mixed polymers	Decrease the amount of non-renewable materials to be extracted from the earth
Design products in a way that reduces material use, use better design instead of over- dimensioning	Decrease the amount of materials to be extracted from the earth
Design for minimum waste production during production	Decrease amount of material wasted during production
Minimize number of materials used	Increase recyclability and ease the sorting process

2.2.2 Production Impacts

Table 2.2: Guideline and Reason for production principle [17].

Guideline	Reason
Avoid or minimize the use of hazardous, toxic or in any other way environmentally unfriendly materials	Decrease amount of harmful gaseous, liquid or solid emissions during production
Minimize and recycle residues and waste from production processes, within the manufacturing plant or outside it	Decrease amount of raw material required and the amount of waste created by production processes
Minimize use of energy-intensive process steps, such as high heating differentials, heavy motors and extensive cooling	Decrease the amount of energy used by the production processes
Optimize use of heat exchangers and similar devices to utilize otherwise wasted heat	Optimization of energy flows in production processes
Minimize losses from production facilities by good construction, service and fast repair. Also provide maximum insulation of walls, pipes and ceilings.	Prevention of losses by leaks, oversized boilers and bad insulation