DESIGN A LOW COST TABLE FAN USING DFMA ANALYSIS

NURUL FARMIRA BINTI ZAKARIA

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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DESIGN A LOW COST TABLE FAN USING DFMA ANALYSIS

NURUL FARMIRA BINTI ZAKARIA

A report submitted
In fulfillment of the requirement for the degree of
Bachelor of Mechanical Engineering (Design & Innovation)

Faculty of Mechanical Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2016

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DECLARATION

I declare that this project report entitled “Design A Low Cost Table Fan Using DFMA Analysis” is the result of my work except as cited in the references.

Signature : .....

Name : NURUL FARMIRA BT ZAKARIA

Date : .....

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APPROVAL

I hereby that I have read this project report and in my opinion this report is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Design & Innovation).

Signature :. .....

Name of Supervisor : DR MOHD AHADLIN BIN MOHD DAUD

Date : .....

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DEDICATION

To my beloved mak and abah.

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ABSTRACT

This project deals with study of Boothroyd Dewhurst Design for Manufacturing and Assembly (DFMA) method in terms of design efficiency to design a low cost table fan. DFMA is a method for designing or redesign product. The advantage of DFMA is able to deliver a systematic procedure to analyzing a proposed design from the point of view of assembly and manufacture, improve the design efficiency, minimize the cost production and fulfill customers' need. The total of part number table fan affecting the design efficiency of the product. To improve the design efficiency, the table fan is analyzed using DFMA method. The result of DFMA analysis is implemented in order to propose a new design of low cost table fan. The project was carried out through dismantle the unit of product, determined the function of each component by evaluating and compare the existing product using DFMA analysis. Lastly is implementing the DFMA analysis result and design guidelines to create a new design by generating a 3D modelling using CATIA V5R20 software. The selection criteria for a good design are based on number of part and operation time. DFMA analysis of optimized design is done and comparative analysis is made between the current and proposed design. The existing product design efficiency is 10.39% for National brand and 11.12% for Pensonic. Result shows that the design efficiency for proposed new design of table fan is obtained better percentage which is 16.61% rather than the existing design. . The final result shows that design efficiency for new design is increased by 5.49 to 6.22%. From the project findings, the number of parts is reduced to 15 parts and the operation time is 180.56s. Eventually, the improvement of table fan design that implemented from DFMA analysis result finally will be able to meet user requirements and satisfactions to design a low cost table fan

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ABSTRAK

Projek ini berkaitan dengan kajian Boothroyd Dewhurst Design for Manufacturing and Assembly (DFMA) dari segi kecekapan reka bentuk untuk mereka bentuk kipas meja berkos rendah. DFMA adalah kaedah untuk mereka bentuk atau produk reka bentuk semula. Kelebihan DFMA mampu menyampaikan suatu prosedur yang sistematik untuk menganalisis reka bentuk yang dicadangkan dari sudut pandangan berhimpun dan pembuatan, meningkatkan kecekapan reka bentuk, mengurangkan kos pengeluaran dan memenuhi kehendak pelanggan. Jumlah bilangan bahagian kipas meja menjejaskan kecekapan reka bentuk produk. Untuk meningkatkan kecekapan reka bentuk, kipas tersebut dianalisis menggunakan kaedah DFMA. Hasil analisis DFMA yang dilaksanakan untuk mencadangkan reka bentuk baru kos rendah kipas meja. Projek ini telah dijalankan melalui pengurangan unit produk, ditentukan melalui fungsi setiap komponen dengan menilai dan membandingkan produk yang sedia ada dengan menggunakan analisis DFMA. Akhir sekali sedang melaksanakan hasil analisis DFMA dan garis panduan reka bentuk untuk menghasilkan reka bentuk yang baru melalui menjana pemodelan 3D menggunakan perisian CATIA V5R20. Kriteria pengambilan reka bentuk yang baik adalah berdasarkan kepada beberapa bahagian dan operasi semasa. Analisis DFMA reka bentuk dioptimumkan dilakukan dan analisis perbandingan dibuat antara reka bentuk semasa dan yang dicadangkan. Kecekapan reka bentuk produk sedia ada adalah 10.39% bagi jenama National dan 11.12% untuk Pensonic. Keputusan menunjukkan bahawa kecekapan reka bentuk untuk reka bentuk baru cadangan kipas meja diperolehi peratusan yang lebih baik iaitu 16.61% daripada reka bentuk yang sedia ada. . Keputusan akhir menunjukkan bahawa kecekapan reka bentuk untuk reka bentuk baru meningkat 5,49-6,22%. Dari dapatan projek, jumlah bahagian dikurangkan kepada 15 bahagian dan masa operasi adalah 180.56s. Akhir sekali, peningkatan reka bentuk kipas meja yang dilaksanakan dari hasil analisis DFMA akhirnya akan dapat memenuhi keperluan dan kepuasan pengguna dalam mereka bentuk kipas meja berkos rendah

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ACKNOWLEDGEMENT

First and foremost, I would like to express my sincere acknowledgement to my supervisor, Dr. Mohd Ahadlin bin Mohd Daud from the Faculty of Mechanical Engineering, Universiti Teknikal Malaysia Melaka (UTeM) for his essential guidance, advices, support and encouragement throughout the completion of this project report.

Special thanks to my family, friends, beloved one, lecturers and technicians for their moral support in completing this degree. Lastly, thank you to everyone that involve during this project is done.

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LIST OF ABBEREVATIONS

TM	=	Assembly time
TK	=	Operation cost
TPC	=	Theoretical minimum part count
NM	=	Theoretical minimal part
DE	=	Design Efficiency

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LIST OF SYMBOLS

E_{ma}	=	Assembly Efficiency
N_{min}	=	Theoretical minimum number of part
t_a	=	Basic assembly time for one part
t_{ma}	=	Estimated time to complete the assembly of the product

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CHAPTER 1

INTRODUCTION

1.1 Background

Design for Manufacturing and Assembly (DFMA) is considered one of the main approaches to concurrent engineering which help in minimize production costs and development time by simplify the components of product to give higher profit to the manufacturer. DFMA combines two concepts of Design for Manufacturing (DFM) and Design for Assembly (DFA) (H. Eskelinen, 2013). The aims of DFA are to improve the products assembly by minimizing the part count and variation as well as reducing the variety of assembly instructions and complexity. Meanwhile, DFM are focusing to improve the product design at minimum cost of manufacturing for maximum manufacturing quality by using the efficient techniques and practices that available (W.A. Knight, 2005). Therefore, DFMA serve a systematic procedure to analyzing a proposed design from the point of view of assembly and manufacture, improve the design efficiency, minimize the cost production and fulfill customers' need (Mendosa, N., Ahuett, H., & Monila, A, 2003).

1.2 Problem Statement

The total part of table fan affecting the design efficiency of the product. The solution to improve the design efficiency is by analyzing using DFMA method. The result of DFMA analysis is implemented in order to propose a new design of low cost table fan.

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1.3 Objective

The main objective of this study is to perform a research and development for manufacturing process on low cost table fan of two different brands by evaluate and compare the design efficiency of the products using DFMA Analysis and suggest the improvement that can be made on the product.

1.4 Scope of Study

The scope of this project is make a comparison the design efficiency of the table fan used for Design of Manufacturing and Assembly (DFMA) for:

1. To identify and select the type of product to studied.
2. To apply and analyse the design efficiency on table fan using Boothroyd Dewhrust (DFMA) method.
3. To compare both design efficiency of table fan.
4. To suggest the improvement to each design based on the DFMA Analysis.

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CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter focuses about the Design for Manufacturing and Assembly (DFMA), Design for Assembly (DFA), Design for Manufacturing (DFM) and overview on previous study cases and perspective approach that related to this project.

2.2 Design for Manufacturing and Assembly

DFMA is the combination of Design for Manufacturing (DFM) and Design for Assembly (DFA). This means the concepts of DFM and DFA are working together which this method significant affects productivity, quality and cost of product and time to market. (Boothroyd, 2002). The fundamental concept of the DFMA paradigm is applied to analyse the manufacturing and assembly problems of a product on the early design stage. Generally, DFMA is used for three main activities as below:

i. As the basic for concurrent engineering studies that to provide guidance to the design team in simplifying the product structure, to reduce manufacturing and assembly costs and to quantify the improvements.
ii. As a benchmarking tool to study competitors' product and quantify manufacturing and assembly difficulties.
iii. As a should-cost tool to help control cost and helps negotiate supplier contracts.

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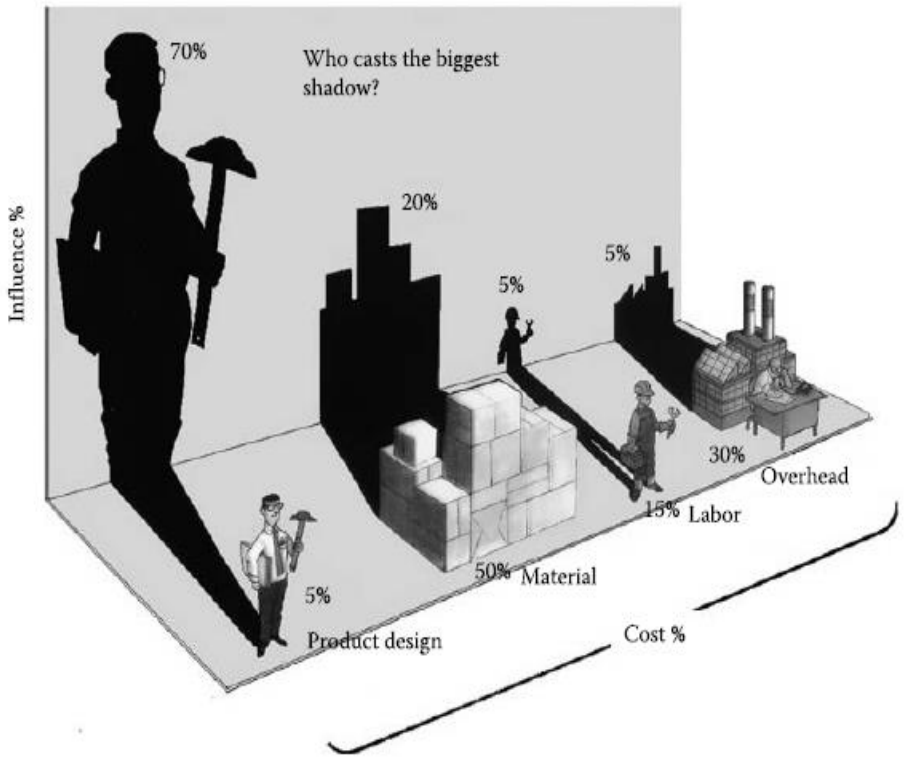

Figure 2.1: Who casts the biggest shadow? (Boothroyd, 2002)

In Figure 2.2, showing that the application of DFMA gives shorten percentage of design time to bring to market compared with traditional design process. Traditional design process is a process that divides in every single phase of development process. The development design process included engineering design, manufacturing, testing, marketing and production. The next phase can only proceed when the previous phase is completed. This process orderly step-by-step very slow and lead product lost sales in competitive market place.

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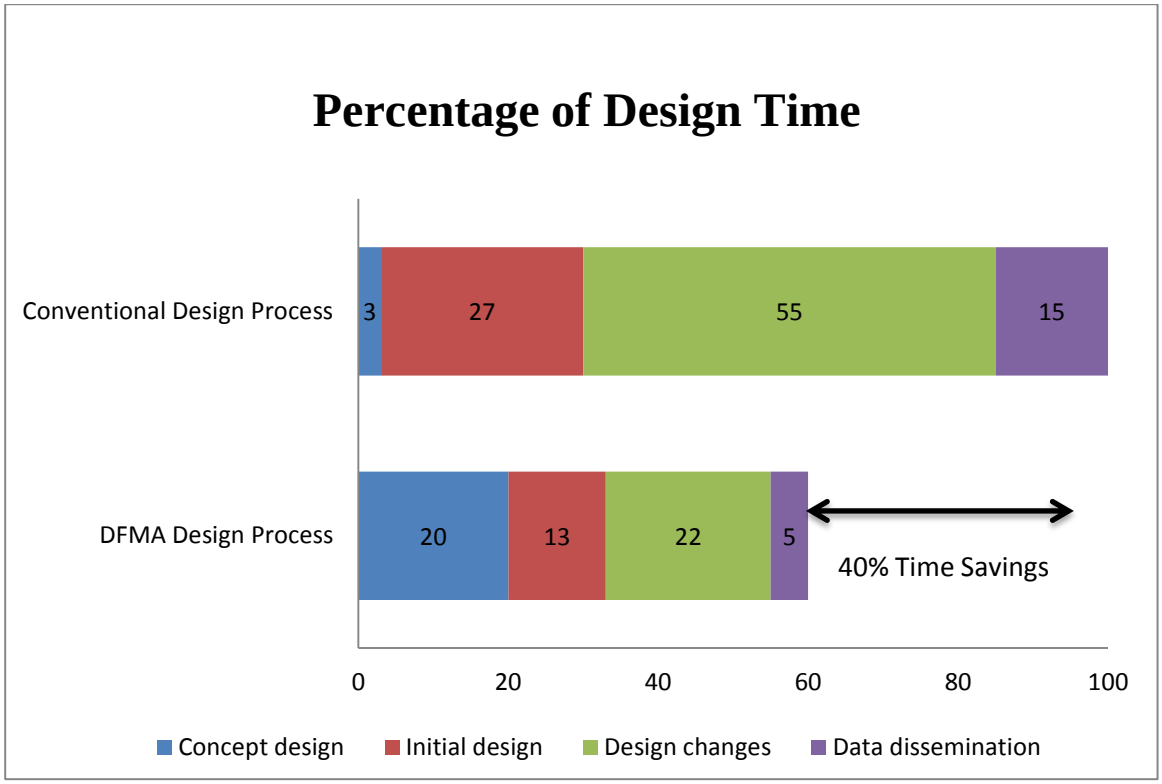

Figure 2.2: Time delivery comparison between DFMA and traditional design process (Boothroyd, 2002)

2.3 Design for Manufacture (DFM)

The term "design for manufacture" (DFM) means the product is designed for easy to manufacture of the group of parts after assembly (Boothroyd, 2002). Beside that, DFM also refers to design activity based on minimizing the production cost and time of the product to market at the same time maintaining the product quality (Mellvyne, 2007). There are five principles that designer need to consider:

i. Minimizing the part count

ii. Minimizing fastener

iii. Standardizing the manufacturing part

iv. Using unidirectional assembly

v. Correct assembly tolerances

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