UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN IMPROVEMENT of a HOUSEHOLD APPLIANCE USING DFMA

This report is submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Design) with Honours

By

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APPROVAL

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ABSTRACT

This project presents about design improvement using DFMA methodology. In order to fulfill the project requirements, two (2) tools are being uses which are Quality Function Deployment (QFD) and Design for Assembly (DFA) analysis. As for this project, an ironing board is selected as a product that to be improve and the improvement is by prioritizing the customers' desires. The process of identifying customer requirement involves of constructing a questionnaire where the feedback is regards to the voice of customers. After that, House of Quality (HOQ) is developed in order to identify the important of the requirement and needs. Base on the HOQ, two (2) design idea and concept is created which are design A and design B. The selection between these two design ideas is distinguished by using Design Evaluation method where morphological chart will be developed in order to do that. The selection keys in the morphological chart are base on the design performance, perceptional quality, reliability and etc. as were state in dimensional of quality. Through this selection method, design B is chosen to be analyzed by using DFA analysis. Boothroyd Dewhurst method is selected as for the analysis. In the analysis, two things are considered which are the manual handling and the manual insertion process in order to gain the insertion and handling time and to calculate the design efficiency of the product. Product is redesign and the design efficiency of the redesign is 26.5% compare to before the redesign 19.3%. At the end of the project, Finite Element Analysis (FEA) analysis is conducted in order to analyze the durability and reliability of each part in the products. The design is analyze using Cosmos Express.

ABSTRAK

Projek ini adalah mengenai perubahan dalam rekabentuk menggunakan kaedah DFMA. Dalam tujuan memenuhi kehendak projek, dua (2) cara digunakan iaitu Fungsi Pembahagian Kualiti (QFD) dan analisis Rekabentuk untuk Pemasangan (DFA). Untuk projek ini, papan seterika telah dipilih sebagai produk yang akan dibaikpulih dengan mengutamakan keinginan pelanggan. Proses untuk mengenalpasti kehendak pelanggan meliputi pembinaan borang soal selidik dimana maklum balas adalah merujuk kepada suara pelanggan. Kemudian, Rumah Kualiti (HOQ) akan diterbitkan dalam mengenalpasti kehendak dan keinginan yang penting. Berdasarkan kepada HOQ, dua (2) rekabentuk idea dan konsep akan dicipta iaitu Rekabentuk A dan Rekabentuk B. Pemilihan antara kedua-dua rekabentuk dibezakan dengan menggunakan kaedah Penilaian Rekabentuk dimana carta morfologi akan dibina dalam melakukannya. Kunci pemilihan di dalam kaedah carta morfologi adalah berdasarkan persembahan rekabentuk, tanggapan kualiti, keboleharapan, dan selainnya yang dinyatakan di dalam pengukuran kualiti. Melalui kaedah pemilihan ini, Rekabentuk B telah dipilih untuk di analisis menggunakan analisis DFA. Kaedah Boothroyd Dewhurst dipilih untuk analisis tersebut. Di dalam analisis itu, dua perkara perlu dipertimbangkan iaitu proses memegang dan memasukkan untuk mendapatkan masa proses memegang dan memasukkan dan untuk mengira kecekapan rekabentuk produk itu. Produk di reka semula dan kecekapan rekabentuk selepas reka semula ialah 26.5% berbanding sebelum reka semula iaitu 19.3%. di akhir projek ini, Analisis Had Unsur (FEA) di lakukan untuk menganalisis ketahanan dan kebolehharapan produk. Rekabentuk akan dianalisa menggunakan Cosmos Express.

DEDICATION

Dedicated to my beloved mother, father, sisters and friends

for their love and support

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LIST of ABBREVIATION

QFD	:	Quality Function Deployment
3D		3 Dimensional
DFA	:	Design for Assembly
PSM		Projek Sarjana Muda
VOC		Voice of Customer
HoQ	:	House of Quality
et al.	:	et cetera
AEM	:	Assembly Evaluation Method
NSF		(National Science Foundation
IBM		International Business Machine
GM		General Manager
CAD		Computer Aided Design
2D		2 Dimensional
3D		3 Dimensional

CHAPTER 1
INTRODUCTION

This chapter will describe and explain the reason on why the project title was selected to be analyzed. The objectives, scopes of the project and the report outlines are also presented in this chapter.

1.1 Introduction

Through the increasing of today's technologies, people are more demanding on fulfilling their needs and requirements. Everything should be perfect and as simple as possible. Many researches have been carried out by the respective person as to improve their productivity and quality other than to fulfill the customer needs. Many product development methods and also the quality tools are being used during the improvement process and researches.

The improvements that they made are based on the voice of customer. The voice of customer will specifically determine a detailed set of what customer wants and needs and organized it into hierarchical structure. The requirements thus then prioritized in terms of relative importance and satisfaction by the customers. The voice of customer studies generally starts when a new product, process or service is conducted in order to better understand what customer wants and needs. The concept of voice of customer may seem straightforward but actually it is quiet complex. Surveys, direct discussion and interview processes are not easy to be set up in order to gather unbiased data which focus on the customer's experiences with current product. The respondents always give an answer that they believe the interviewer

desires to hear which the results often do not correlate well with customers' actual wishes (Halbeib *et al.* 1993).

1.2 Background of Project

Achieving success with new product development in markets is becoming more and more challenging. Due to shortening product life cycles, businesses are looking for ways to reduce product development time and to introduce their products to the market more quickly. Additionally, customers are demanding in the fulfillment of their needs faster and with customized products.. In order to meet customer needs, the QFD method is apply in the process of design development. In this project, QFD method will be used in identifying customer needs and transferring this information along to product design development. The DFA process will then be apply in this project along the process of design development according to the information gather from the QFD method. The design develop will then be evaluate its characteristics by considering the safety aspect, products performance and function and other appropriate aspects will be include.

1.3 Problem Statement

Many products nowadays had simplified human work but not all of them fulfill the consumer satisfaction. Among these were household appliances. People use this product daily and they are expecting the product to be long lasting, user friendly and robust.

Ironing board is one of the household appliances too. Basically, every house would have at least one (1) iron board. Professionals, students and even housewives will use iron board at least once a day in their day life. Since this product is being used frequently, consumer expects that these products are more durable, long lasting and easy to use. Feedbacks given by users saying that they are many problems that associated with the need of existing iron board. One of the problems is that the iron

cord got entangled easily. The cord is long and basically, this problem occurs when the iron cord is not roll correctly. Other than that, the board padding covers can easily burn and thus leaving uneasy mark that cannot be removing unless the padding cover is change with other pieces of cloth. Furthermore, the iron holder also gives problem to the consumers. It tends to bend downward and no longer safe to put the hot iron on it. Sometimes the iron holder dragged out from the board.

The aim of this project is to analyze the current ironing board available in the market and try to suggest the improved design that will satisfied the consumer's needs and requirements.

1.3 Objectives of Project

In order to fulfill the aim of the project, the following objectives are proposed:

a) To analyze the current ironing board using QFD tools.
b) To propose new design using DFA tools so that the product is more marketable and flexible.

1.4 Scopes of Project

The scopes of this project are:

a) The ironing board is of the domestic type.
b) The proposed product is presented in 3D drawing

1.5 Report Outlines

The project consists of 6 important chapters. Chapter one will describe about the introduction of project, the problem statement and also stated there are the objectives and the scopes of the projects.

Chapter two will presents about the literature review of the project which in this project, it will cover about the QFD tools, DFA method and also a brief description about the product itself.

Chapter three will describe about the process flow of the project and Gantt chart which indicates the schedule of the whole project plans that to be followed in order to achieve the time target of completing the project.

All information and data gained regarding to the project are stated in chapter 4 of this report. Data are collected base on the feedback from the questionnaire. The House of Quality matrix is also representing in this chapter.

Chapter 5 indicating the discussion of the project where the solution of problems is determines. Base on the solution made and also from the finding of the House of Quality, two design idea and concept is develop and the selection between these designs is made by using design evaluation method (dimension of quality). The selected design and the redesign of the product will be analyzed using DFA analysis. The selected design is distinguish in term of its design efficiency by using Boothroyd Dewhurst method. The capability of the product to withstand with the force applied is also analyze in this chapter.

The final chapter is about the conclusion of the overall project. This chapter state whether the objective of this project achieved or not and what are the suggestion for the improvement if the objective is not successfully achieved.

CHAPTER 2
LITERATURE REVIEW

In order to accomplish the project, the knowledge about the tool and method that will be carrying out should be identifying. As in this project, two methods are being use which is QFD (Quality Function Deployment) tool and DFA (Design for Assembly) method. Here, the originality and the process of applying these two tools will be explained. Other than that, this chapter will also briefly explain about the history of the ironing board itself.

2.1 Introduction to QFD (Quality Function Deployment)

Quality Function Deployment (QFD) is a method of product development where the product or process is directed from the Voice of the Customer (VOC) through development of requirements, specifications design feature development, process selection and process control. It is generally used in the early phase of new or improved products/services design process, and therefore most of the input parameters are highly subjected in nature. The QFD methodology can be used for both tangible products and non-tangible services, including manufactured goods, service industry, software products, IT projects, business process development, government, healthcare, ecological initiatives and many other applications.

QFD is a structured approach to defining customer needs or requirements and translating them into specific plans to produce products to meet those needs. The "voice of the customer" is the term to describe these stated and unstated customer needs or requirements. The voice of the customer can be made within the direct discussion or interviews, surveys, focus groups, customer specifications, observation,

warranty data, field reports, etc. This understanding of the customer needs is then summarized in a product planning matrix or "House of Quality". These matrices are used to translate higher level "what's" or needs into lower level "how's" product requirements or technical characteristics to satisfy these needs (Kai and El. Haik, 2003).

2.1.1 History/Originality of QFD

QFD was developed in Japan in the late 1960s by Professors Shigeru Mizuno and Yoji Akao. At the time, statistical quality control, which was introduced after World War II, was first applied in the Japanese manufacturing industry. The purpose of Professors Mizuno and Akao created this QFD method is to develop a quality assurance method that would design customer satisfaction into a product before it was manufactured. Prior to this, quality control methods were primarily aimed at fixing problem during or after manufacturing (Akao, 1997a).

In 1972, with the application of QFD to the design of an oil tanker at the Kobe Shipyards of Mitsubishi Heavy Industry, the fishbone diagrams grew unwieldy. Since the effects shared multiple causes, the fishbone refashioned into a spreadsheet or matrix format with the rows being desired effects of customer satisfaction and the columns being the controlling and measurable causes. They systematized the customer's needs in term of function and showed the relationship between these functions and the quality characteristics. These provided guidance from Dr. Shigeru Mizuno and Dr. Yasushi Furukawa in developing the diagrams. The first large scale application was presented in 1966 by Kiyotaka Oshiumi of Bridgestone Tire Corp. in Japan. They applied a process assurance items fishbone diagram to identify each customer requirement (effect) and to identify the design substitute quality characteristics and convert it into the process factors (causes) which needed to be control and measure it (Akao, 1997b).

QFD reached its peak in Japan in the 1970s when Toyota Auto Body developed a quality table that and a "roof" on top, and nicknamed this quality table as a "quality