"I/We hereby declared that I/we have read through this report
and found that it has comply the partial fulfillment for awarding the degree of
Bachelor of Mechanical Engineering (Design and Innovation)"

Signature :

Supervisor Name : Mr. Shafizal Bin Mat

Date : ……

DESIGN AND ANALYSIS OF OPTICAL MOUSE USING BOOTHROYD DEWHURST DFMA METHODOLOGY

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This report is submitted as partial
fulfillment of the requirement for the award of
Bachelor of Mechanical Engineering (Design and Innovation)

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APRIL 2010

"I hereby declared that this report is a result of my own work except for the excerpts that have been cited clearly in the references"

Signature : ……

Name : Khairul Aidil Bin Nordin

Date : ……

Especially to my beloved parents,

My lovely brothers,

My respectfully lecturers,

Also my faithfully friends,

Your prayers always with me every way that I went…

ACKNOWLEDGEMENT

In this great opportunity, I would like to thank Allah for providing me strengths to completing this report. Here, I would like to acknowledge with appreciation to all those people who helped me numerously during completing this project.

In a particular, I would like to convey my sincere thank you to my supervisor Mr. Shafizal Bin Mat, for giving me chance to do the project under his supervision. I also would like to thank to him for teaching me more in mechanical engineering subjects especially works for my topic. He also guided me and given advised based on his experience during my progress of this project. His constant encouragement and guidance had brought me to completing my project.

Not to forget, I would also like to express my appreciation to thank to all my friends especially class of 4 BMCD for being kind and helpful to me until the project done. Finally, thank to my beloved parents who had give me encouragement until this project done. Thanks for your guidance and cooperation.

ABSTRACT

This project is purpose to create technical research for undergraduate students which have high potential in technical paper publication. Throughout this project, an existing optical mouse will separated each part purpose to do analysis and to critique the assembly point of view. After done the analysis, by using the Boothroyd-Dewhurst method some of the part will eliminate or reduce and redesign remain part as possible and come out with the some conceptual design. To ensure the purpose is achieved, some of the important element must be consider, there are followed the scope of project such as, literature review of the DFMA. In this project, all the design drawing, drawn by using the CATIA software. Finally, the new design will be compared with the original design from aspect, assembly cost, assembly time, part quantity and design efficiency. Base on calculation, the result had been containing for manual analysis, the percentage of design efficiency is 67.2 %, and for software analysis, the percentage of design efficiency is 71%. For percentage of part quantity, the result is 60% for both analyses. The result for percentage of assembly time is 70.3% for manual analysis and 63.82% for software analysis. Mean while the percentage of assembly cost is 70.3% for manual analysis and 66.7% for software analysis. From the overall result, the result obtained in software and manual analysis was not much different. For example, in result of design efficiency, the different values in manual result and software result for existing design was not much different. For manual existing design efficiency the result is 0.134 and for software the result is 0.1305. This project has shown the correct method to design and analyze optical mouse using Boothroyd-Dewhurst DFMA methodology

ABSTRAK

Projek ini adalah bertujuan untuk mewujudkan penyelidikan teknikal bagi pelajar prasarana yang mempunyai potensi besar untuk penerbitan kertas teknikal. Di dalam projek ini, tetikus optic yang berada di pasaran sekarang dipilih dan akan diceraikan satu persatu untuk menjalakan analisis dan memberi sudut pandangan terhadap tetikus tersebut. Setelah menjalankan analisa dengan menggunakan kaedah "DFMA", rekabentuk baru di cipta denggan mengeluarkan beberapa konsep rekabentuk untuk mempertingkat kan kos pembuatan dan mengurangkan bilangan pada rekabentuk lama. Untuk memastikan matlamat projek tercapai mengikut ruang lingkup yang bersesuaian, kajian ilmiah yang terdahulu dijadikan sebagai rujukan. Didalam projek ini juga, semua rekabentuk dilukis dengan menggunakan perisian "CAD" iaitu perisian CATIA. Dan akhir skali rekabentuk baru akan dibandingkan dengan rekabentuk sedia ada dari aspek kos pemasangan, kos pembuatan dan kecekapan pemasangan. Berdasarkan analisis yang dijalankan, hasil yang telah diperolehi untuk peratusan kecekapan rekabentuk adalah 67,2% untuk manual analisis, dan untuk analisis perisian, peratusan kecekapan rekabentuk adalah 71%. Untuk peratusan jumlah bahagian, hasilnya adalah 60% untuk kedua analisis. Keputusan untuk peratusan masa pemasangan adalah 70,3% untuk analisis manual dan 63,82% untuk analisis perisian. Sementara peratusan kos pemasangan adalah 70,3% untuk analisis manual dan 66,7% untuk analisis perisian. Dari hasil keseluruhan, hasilnya diperolehi dalam perisian dan analisis manual tidak jauh berbeza. Contohnya, dalam keputusan kecekapan rekabentuk, nilai-nilai yang berbeza pada hasil manual dan keputusan perisian untuk rekabentuk yang sudah ada tidak jauh berbeza. Untuk kecekapan rekabentuk manual yang ada hasilnya adalah 0,134 dan untuk perisian hasilnya adalah 0,1305.

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CHAPTER 1

INTRODUCTION

1.1 General

Design for Manufacturing (DFM) and design for assembly (DFA) are the integration of product design and process planning into one common activity. DFMA can define as "*a process for improving product design for easy to manufacture and low-cost assembly, focusing on functionality and on assimilability concurrently*."

The goal of designing for manufacturing and assembly (DFMA) is to design a product that is easily and economically manufacture and assembly. On the other words is to improve the design of the assembly, to reduce the adhesion such as welding operation necessary to end up with a finished product. The most common methods of improvements are reducing the number of times the part have to be reoriented, and eliminating any excess material without sacrifice the product quality (George A. Bekey, 1993).

The importance of design of designing for manufacturing and assembly is underlined by the fact that about 70% of manufacturing cost of a product (cost of materials, processing, and assembly) is determined by design decision, with production decisions (such as process planning or machine tool selection) responsible while

decisions made during production only 20%. Further, decisions made of the product's cost, quality and manufacturability characteristics (Piere De Lit, 2003).

1.2 Objectives

The goals of this project are:

i. To design and analyze of optical mouse using Boothroyd-Dewhurst DFMA methodology.
ii. To compare of between existing product and proposed design.
iii. To improve the assembly efficiency of existing product and proposed design.

1.3 Scope Of The Project

To ensure the objectives are achieved, some of the important element must be considered. There are as follow:

i. Literature Review.
ii. Drawing of existing design using the CATIA.
iii. Analysis of existing design using Boothyord-Dewhurst DFMA.
iv. Conceptual design and Detail design for the modification of existing product drawn by using CAD.
v. Boothyord-Dewhurst DFMA analysis of the existing and proposed design.
vi. Comparison between existing and proposed design

1.4 Problem Statement

There are several significant problems regarding to the project that exists in the case study:

i. Maximum number of subassembly part which less or not functions
ii. The cost price of the existing product high because using excessive raw material and more purchases part (such as screws) used.
iii. Is difficult or complicated in assembly process.

CHAPTER 2

LITERATURE REVIEW

2.1 Designs for Manufacture and Assembly (DFMA)

A literature review is a body of text that aims to review the critical point of current knowledge on a particular topic. Base on literature review, it provides general up to date ideals, theoretical concept and applications related to this project. This literature review will go through those topics related to Design for Manufacturing and Assembly (DFMA), Design for Assembly (DFA) and Design for Manufacturing (DFM) where has become an important concurrent engineering imperative for cost effective product design. The basis of DFMA is a systematic procedure for analyzing product design based on the application of the application of quantifiable data. This chapter also explained the basic concept and method of Boothroyd Dewhurst DFMA. The method is described for effective integration of quantitative and qualitative materials, manufacturing and assembly process information during product design.

Modern production systems have introduced a broad range of technologies to help accelerate the manufacturing process, but it is now well recognized that many of the decisions that are made at the concept design stages have a major impact on the success of the final project. Hence, the term “design for manufacturing (DFM)” means the design for ease manufacture the product after assembly and term “design for assembly (DFA)” means the design for ease of assembly. Thus, to be effective in product design,

the both term are often combined as Design for Manufacture and Assembly (DFMA). Buss et al. (2001) agreed with this point of view, saying that the DFMA allows bring the product design to be effective if the considerations of design related to the assembly and manufacturability of the product.

Design for manufacture and assembly, or DFMA it has become to known, is now a widely accepted technique and are use in many manufacturing industries around the world purpose to earn more profit. There are three goals in DFM (Xiaofan Xie, 2002):

i. Increase the quality of new produces during the developing period, including design, technology, manufacturing, assembly, service and so on.
ii. Decrease the cost, including the cost of design, technology, manufacturing, delivery, technical support, discarding and so on.
iii. Shorten the developing cycle time and increase productivity including the time of design, manufacturing preparing, and repeatedly calculation.

Examples now prove that DFMA analysis provides much greater benefit than a simple reduction in-assembly cost. In fact, it appears that DFMA is the key to very significant reduction in overall manufacturing cost.

DFMA is used to provide accurate cycle time and manufacturing costs at the conceptual stage of the design cycle. This enables engineers to make more informed decisions for design optimization before it is too late make any changes. A few of these simple principles are:

a) Minimize the number of part
b) Minimize the number of assembly operations
c) Improve access and visibility
d) Maximize part compliance
e) Apply modular designs principles
f) Mistakes-proof part

Commonly, the incentive for considering design for manufacture and assembly is the need for improved productivity and cost performance. It has become widely accepted that first step in assessing the feasibility of automated assembly is the consideration of the product design and making changes to make automation plausible.

Since all this done at the design stage, the result is the optimum product design and before too much time and money has wasted in unnecessary planning, tooling and perhaps actual production of eliminated parts (Mark Curtis, 1990).

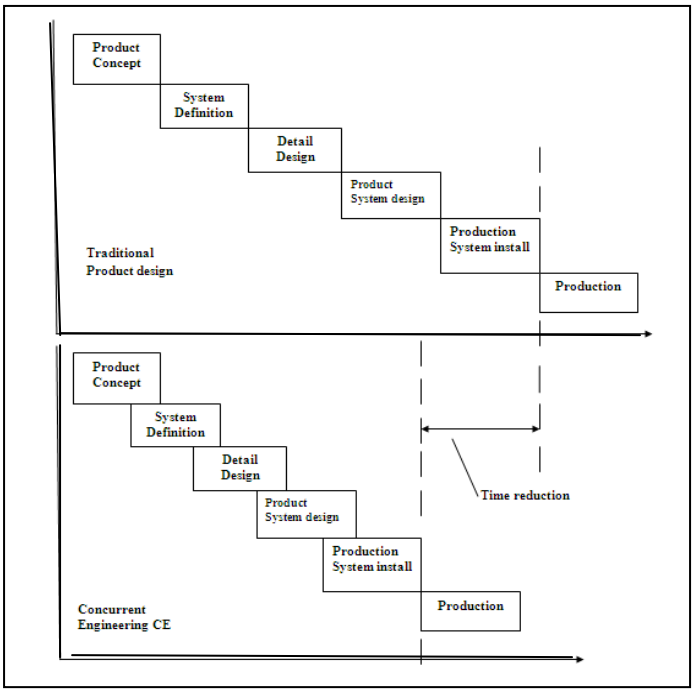

Figure 2.1: Traditional product development compared to concurrent engineering (Source: Stephen Eskilandar, 2001)

2.2 History and Background of Design for Assembly (DFMA)

In the 1960's and 70's various rules and recommendation were proposed in order to help designer consider assembly problems during the design process. Many of these rules and recommendations were presented together with practical examples showing how assembly difficult could be improved. However, it was not until the 1970's that numerical evaluation method were developed to allow design for assembly studies to be carried out on existing and proposed design.

The first evaluation method was developed at Hitachi and was called the Assembly Method (AEM). This method is based on the principal of "one motion for one part." For more complicated motions, a point-loss standard is used and the ease of assembly of the whole product is evaluated by subtracting points lost. The method was originally developed in order to rate assemblies for ease of automatic assembly.

Starting in 1977, Geoff Boothyord, supported by NSF grant at the University of Massachusetts, developed the design for Assembly (DFA) method; it is based on timing each of the handling and insertion motion which could be used to estimate the time for manual assembly of a product and the cost of assembling the product on an automatic assembly machine. Recognizing that the most important factor in reducing assembly costs was the minimization of the number of separate parts in a product, he introduced simple criteria which could be used to determine theoretically whether any of the parts in the product could be eliminated or combined with other parts. U.K. Unlike the Boothroyd Dewhurst method, the Lucas method is based on a "point scale" which gives a relative measure of assembly difficulty. Lucas DFA method definitely based on the parts count analysis stage with is known as terms "functional analysis".

Starting in 1981, Geoffrey Boothroyd and Peter Dewhurst developed a computerized version of the DFMA method which allowed its implementation in a broad range of companies. For this work they were presented with many awards