UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DFA Using Computer Program

This report 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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DECLARATION

I hereby declare that this report entitled **"DFA Using Computer Program"** is the result of my own research except as cited in the references.

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (*Manufacturing Design*). The members of the supervisory committee are as follow:

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ABSTRACT

Design for Assembly (DFA) nowadays is very important in product development. The design, assembly and the disassembly of each part can affect the production cost and time. When DFA performed at the earliest stages of concept design, it has the potential to greatly influence manufacturing up to 40- 60 percent production period and 65 to 85 percent of manufacturing costs. DFA software can help DFA process easier, accurate and precise than manual process. This study is to develop a computer programming by using visual studio software and finally has to test the software and compare the outcome result with the manual process. Additional to that, it also discover about DFA method. A DFA process was studied before the programmings were started. The Boothroyd Dewhurst method was chosen as a method that used in this analysis. The product that has been analysed is a mini tripod camera. Visual Studio Express 2008 was used as a platform of the software. By using visual studio, the DFA software was created. By taking the outcome result, the comparison was made between using DFA software and manual DFA.

ABSTRAK

Pada zaman ini, penggunaan rekabentuk untuk pemasangan adalah sangat penting dalam pembangunan produk. Pemasangan dan penanggalan untuk setiap komponen mempengaruhi masa, tenaga dan juga kos. Apabila pemasangan untuk rekabentuk diaplikasikan pada peringkat awal rekabentuk, ianya boleh menjimatkan antara 40 hingga 60 peratus masa pengeluaran dan juga 65 hingga 85 peratus kos pembuatan. Penggunaan perisian rekabentuk untuk pemasangan boleh membantu memudahkan, meningkatkan kepersisan dan juga ketepatan berbanding dengan menggunakan kaedah manual. Projek ini adalah untuk membangunkan sebuah perisian pemasangan untuk rekabentuk dengan menggunakan perisian Visual Studio. Perisian tersebut akan diuji dan dibandingkan keputusannya dengan menggunakan kaedah manual. Tambahan kepada itu, ia juga bertujuan untuk mempelopori dan mendalami tentang rekabentuk untuk pemasangan. Sebelum memulakan projek, kaedah rekabentuk untuk pemasangan dikaji terlebih dahulu. Kaedah Boothroyd Dewhurst akhirnya dipilih sebagai kaedah untuk menganalisis produk. Produk yang dianalisis adalah penyokong kamera mini. Visual Studio Express 2008 telah dipilih sebagai asas untuk program ini. Dengan mengambil keputusan, perbandingan dibuat diantara menggunakan perisian yang telah dibina dan juga secara manual.

DEDICATION

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DFA	-	Design for Assembly
RE	-	Reverse Engineering
PSM	-	Projek Sarjana Muda
PC	-	Personal Computer
3D	-	3 Dimensional
UTeM	-	Universiti Teknikal Malaysia Melaka
mm	-	Milimeters
CAD	-	Computer Aided Design

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter presents the background of the project, problem statement, objective and scopes of the project. Background of the project describes about the project. Problem statement states the reason for execute the project. The objectives of the project are the aim of the project and the scopes explains about the limitations of the project.

1.2 Background

DFA is a complements Design for Manufacture (DFM). Engineers use DFA software to reduce the assembly cost of a product by consolidating parts into elegant and multifunctional designs. DFM software then allows the design engineer quickly to judge the cost of producing the new design and to compare it with the cost of producing the original assembly. Used together, DFM and DFA software gives engineers an early cost profile of product designs, providing a basis for planning and decision making. Such analyses, when performed at the earliest stages of concept design, have the potential to greatly influence manufacturing and other life-cycle costs before the cost were calculated. Engineers know that 40%- 60% production period and 65% to 85% percent of manufacturing costs are determined in the early stages of design. When Engineers

make informed design decisions during the concept stage, they avoid costly corrections later on. This project is purposed to develop of Design for Assembly (DFA) software by using visual basic programming. This project focused on Design for Assembly. Now days, there are many DFA software available in market for manufacturing process such as TeamSET, MA/PCB from Mentor Graphics Corp., San Jose, CA, and DFA (Design for Assembly) developed by AT&T Co. However the market price for these software are very expensive and can only be used by big companies. The main purpose of this project is to produce a low cost DFA soft ware.

1.3 Problem statement

Software Design for Assembly (DFA) has been known as an effective method to reduce part in design stage and indirectly reducing cost of the product. This software is also used for producing effective shape for the product. Nowadays, many of the companies use DFA software as a solution to produce a product with minimum wastage scrap and reject part. However, most of the existing DFA software is very expensive. Company that produce DFA software also sometimes limiting the usage of the software only for industry. Students in university or college have some difficulty to learn about the DFA software. Therefore this DFA software is developed for university and college student usage.

1.4 Objective

The objectives of this project are:

i. To study programming software based on the visual studio.

ii. To gain knowledge about Design of Assembly (DFA) methodology.

iii. To develop a computer programming and finally has to test the software and compare the manual outcome result.

1.5 Scope

The scopes of this project are:

i. Apply this methodology by applying to an existing product

ii. Use visual studio to create the program.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

In this chapter, the definition and the approach of the Design for Assembly (DFA) and Visual Basic (VB) will be explained. The step in implementing guideline in DFA and Visual Basic will be described. The manual analysis of the product by using Boothroyd Dewhurst method will also be discussed.

2.2 Design for Assembly (DFA)

Design for assembly (DFA) is a well-known technique for reducing manufacturing costs and improving parts quality. DFA has been used widely since the mid- 1980's, introduced by Geoffrey Boothroyd and Peter Dewhurst, who were responsible for developing much of the underlying material (G. Boothroyd, P. Dewhurst, and W. Knight, 1994).

DFA emphasizes improving the assembly process by reducing the parts count, making individual parts easy to assemble correctly, and making it difficult to create errors in the assembly process. It has many direct and indirect benefits to the design of the product. The direct benefits typically include a reduction in fixed and variable assembly costs, either manual or automatic. A product designed according to DFA principles requires fewer assembly machines, the machines that are required are simpler, fewer assembly

workers are required, and the task difficulty of assembly work is lowered. Indirect benefits from DFA include a reduction in the need for inspection, a reduction in the number of suppliers, simplification of inventory control mechanisms, an increase in the reliability of the product, and a reduction of lifetime service and maintenance costs. (Robert P. Smith, 1998)

Assembly is an important process to consider for two reasons: its ubiquity and its role as system integrator. Almost all products are assembled, so improving the assembly process has benefits to all industries. And since assembly is typically the final manufacturing process it can bring to light problems that arise at earlier stages in the manufacturing system, such as quality problems in piece-part production or scheduling problems in part delivery. Recognition of the benefits of concentrating on assembly as a key process is long-standing (R. P. Smith 1997).

For the same reasons that assembly is a key process in the manufacturing process: integration and assembly has always been important. Good design practices and engineers have long emphasized assembly as a key goal toward improving the manufacturing process of a product. DFA as a technique is beneficial to both automated and manual assembly processes. Automatic assembly is more closely linked with DFA methodology because in many cases automatic assembly is impossible without applying DFA. (Robert P. Smith, 1998)

DFA is a process of improving product designs for easy and low cost assembly. An assembly-conscious design is desirable because it could result in significant savings in capital costs and assembly time. For example, the IBMCorp operation has successfully applied the concept of DFA into of its printer model and redesigning and reducing the number of parts, which drastically lowered the printer's assembly cost, and price (Bailey, 1995)

An assembly-conscious design is difficult, in general, because designers tend to focus only on the functionality of the product. Considering "assemblability" concurrently with the functionality of a product seems to be a major source of distraction that most traditional designers would like to avoid. This is especially apparent when there exist many parts exerting various constraints upon one other. Therefore, there is a desire to automate the DFA process, at least partially, through the use of computers (Gerard J. Kim, George A. Bekey and Kenneth Y. Goldberg, 1992)

DFA is of considerable importance since the assembly operation is often responsible for more than 50 per cent of total manufacturing cost and 40 per cent to 60 per cent of total production time besides the potential reduction in cost. DFA offers the promise of additional benefits in increased quality, increased reliability, and a shorter manufacturing time. Several DFA systems have been developed, such as the Lucas system, the Boothroyd and Dewhurst system and Hitachi's AEM. In these systems, the designs are evaluated on aspects such as their ease of part handling, feeding, insertion, orientation and geometric attributes. Typically, a numerical figure is used to represent the results and the designer can then modify the design with the aim of improving the result. Design improvements can be made by iteratively repeating this process. However, the designer can have some difficulty visualizing the assembly operation with the consequence that decision making may be impaired. (Wen-Chieh Chuang and Peter O'Grady, 1999)

G. Kim, K. Goldberg and G. Bekey, 1992 has stated, although above methods have proven to be effective, the analysis procedure can be enhanced to reflect a more realistic DFA measure by:

(1) Considering a particular sequence of assembly, and

(2) Considering design rationales

2.3 Attributes of DFA techniques

DFA addresses assembly quality largely through product structure simplification and reduction in the total numbers of parts in a product. Redford and Chal, (1994) has stated that any DFA method should have the following features:

i. It should be a complete method as regards to procedures for evaluating assemblability and should be creative enough to obtain procedures for improving assemblability.
ii. It should be a systematic step-by-step procedure, which considers all relevant issues.
iii. It should be able to measure assemblability objectively, accurately, and completely.
iv. It should be user friendly and should have good quality.

2.3.1 DFA systems using design principles and design rules

Design rules are empirical 'truths' verified by extensive design practice which help in this type of DFA method. Suh, (1998) proposes two basic axioms for design with consequence. The basic axioms are:

i. Maintain the independence of functional requirements; and
ii. Minimize the information content.

Some of the corollaries include using standardized or interchangeable parts whenever possible, conserving materials and energy or reducing the number of parts.

2.3.2 DFA systems employing quantitative evaluation procedures

Quantitative DFA analysis allows designers to rate the assemblability of their product designs quantitatively. Quantitative measures allow a more accurate and repeatable

application of DFA methods. Using current quantitative approaches, the designer has to determine the assembly process operation by operation. Each assembly operation is subject to a rating that assesses the ease with which operators or assembly systems carry out the process. There are several quantitative evaluation methods like Hitachi's assembly evaluation method (AEM), the Boothroyd and Dewhurst method, the Xerox Producibility Index or assembly trees. Extensions to such methods include the subtract–operate procedure and force flow analysis for piece count reduction in a product.The most popular method of this category is the Boothroyd and Dewhurst method. (Robert B. Stone, etc all, 2003)

2.3.3 DFA methods employing knowledge-based approaches

Knowledge-based systems are defined as those that provide new information- processing capabilities such as inference, knowledge-based management, or search mechanisms combined with conventional computer capabilities. (Robert B. Stone, Varghese J. Kayyalethekkel and Daniel A. McAdams, 2003)

2.3.4 Computer-aided DFA methods

In this category, assemblability evaluation processes are being developed by which DFA systems are integrated with CAD. Assemblability data are extracted from 3D CAD models using feature processing. The part model can give useful data for the assemblability evaluation such as shape symmetry and center of mass. The Lucas method is a good example of this type of DFA approach. (Swift K, 1989)