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COMPARISON FOR FRONT DOOR PASSENGER CAR WITH LOCAL AND IMPORT CAR USING DESIGN FOR MANUFACTURE AND ASSEMBLY (DFMA) METHOD

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Laporan ini dikemukakan sebagai
memenuhi sebahagian daripada syarat penganugerahan
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SPECIALLY DEDICATED TO MY BELOVED FATHER, MOTHER AND OTHER FAMILY MEMBER

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ABSTRACT

Design for manufacture and assembly (DFMA) guidelines reduce the part count, the number of welds, and the number of operations. This reduces labor costs by achieving a shorter assembly time, decreases start-up costs by eliminating the need for several operations, and reduces material costs by eliminating parts. Design for Manufacture and Assembly (DFMA) technique has been utilized extensively in industry field these days. This paper is a detailed review which will discuss the application on DFMA. Using Boothroyd and Dewhurst Method, it employs a quantitative analysis of the design. Each part of the design is rated with a numeric value depending on its manufacturability. The numbers are summed for the entire design and the resulting value is used as a guide to the overall quality of the design. The product is then redesigned, using the numerical values as a goal to be minimized. This again, however, requires much insight and knowledge on the part of the designer. This DFMA tool not only will perform a reverse engineering product and process analysis, but also help the user to explore alternative solutions.

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ABSTRAK

Kaedah Reka Bentuk Untuk Pembuatan Dan Pemasangan (DFMA) memberi panduan untuk pengurangan bilangan bahagian, jumlah kimpalan dan jumlah operasi. Ini dapat mengurangkan kos buruh dengan pengurangan masa pemasangan, pengurangan masa permulaan kos dengan mengurangkan beberapa operasi dan pengurangan kos bahan dengan pemansuhan bahagian. Kaedah DFMA telah dititik beratkan dalam industri pada masa sekarang. Analisi ini akan memberi gambaran terperinci yang akan membincangkan aplikasi terhadap DFMA. Menggunakan kaedah Boothroyd dan Dewhurst, analisis terhadap kuntiti reka bentuk akan dititik beratkan. Setiap bahagian akan dinilaikan dengan nilai berangka dan ia bergantung pada proses pembuatanya. Jumlah akan dicampurkan terhadap seluruh reka bentuk dan keputusan nilai akan digunakan sebagai panduan untuk kualiti keseluruhan reka bentuk tersebut. Produk tersebut akan direka semula menggunakan nilai berangka bertujuan untuk pengurangan bahagian. Walaubagaimanapun, kaedah ini memerlukan banyak pengetahuan terhadap bahagian pereka tersebut. Kaedah DFMA bukan sahaja alat untuk kejuruteraan balikan bagi sesuatu produk, tetapi ia adalah satu alternatif untuk membantu seseorang mempelopori kaedah lain dalam sesuatu proses yang akan memberi manfaat kepada industri pembuatan.

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CHAPTER 1

INTRODUCTION

1.1 General Introduction

The automotive body is perhaps the most important vehicle system in terms of impact, time, cost, and customer satisfaction. For the car impact, the body defines the vehicle platform, which has many model variants. Models are often redesigned, often requiring completely new bodies. The time taken for the body is always on the critical vehicle development path, as obtaining and installing the tooling to stated quality requirements in an organized fashion always seems to take more time than is available. Often tooling is reworked until the project schedule dictates that it be finished. The cost for the body is arguably the most costly vehicle system, second only to the power train. However, the power train is often developed once for many vehicle models, whereas the body is redesigned for every model. When introducing a new vehicle model, costs associated with changes in the body are usually dominant.

The goal of this analysis involves making comparison for front door passenger car with local and import car and to make the design more manufacturing- and assembly-friendly by reducing part count, assembly time, and costs associated with manufacturing. The quality of the design should also improve as a result of these changes. Design for manufacture and assembly (DFMA) is the process by which designs and assembly sequences and procedures are altered to increase the ease and effectiveness of automated assembly. However, applying this approach to automation requires a paradigm shift in the approach to manufacturing if it is to be effective. In the past, design and manufacture tasks have been performed

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independently. In this scenario, the designer designs a product and ‘‘tosses it over the wall’’ to the manufacturer to produce. There is no interaction between the designer and manufacturer and often what results is a design that is difficult to produce using automation. What is required is collaboration between all aspects of the engineering staff, beginning with product conception all the way through delivery. By tapping into the expertise of all engineering areas (design, automation, manufacturing,), an equally functional and high quality design will result, but it will be much easier to reliably manufacture in an automated system. In practice, this approach is often difficult to implement, especially if the product designers are employed by one sub-contractor, the machine builders by another, and the raw components manufactured by a third. However, time spent by all involved parties in mutual consultation at the design phase will far out weigh any inconveniences.

1.2 Objective

The objectives of this study are to minimize the number of setup, stages and analyze the existing manufacturing and assembly function.

1.3 Scope

The main scope in this project is to take one sample of a door car from local and import product and analyze the setup stages before minimize it. The door car that will be analyzed is Proton Wira 1.5 and Honda Civic 1.5, both door are taken on the front left hand side of a passenger.

Other scope that will be study:-

- Revisit the physical structure (of the design) which customize to the local processing capability.

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- Apply the most appropriate (not latest) technology.

- Design for minimum number of parts using physical coupling
- Choose the appropriate material for easy manufacturing

- Apply the layer assembly principles.

1.4 Problem Statement

Front door car is the important part that determines the quality product of a car. It consists of many components that are power window, central lock, door handle and many more. If the comparison was made on local product and import product, a lot of differentiation can be seen from the aspect of quality and cost. So, DFMA (Design for Manufacture and Assembly) method was used to make the comparison and to decide whether to reduce the part of a product components that is to cut of the cost and the result from this method will determine the quality or not.

Below are the problems that occur when performing the DFMA (Design for Manufacture and Assembly) Method:-

i. The problem in minimize part count through internal part occur when we try to reduce modularization and the complexity also increase on this stage.

ii. The problem in minimizing fasteners are:-

- Fasteners are stronger and hard to be split out

- Fasteners can be used to locate part and when the fasteners gone, it is hard for us to locate other part that is related to fasteners.

- Less sensitive to part variation

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CHAPTER 2

LITERITURE REVIEW

2.1 Development History of DFMA

For over 500 companies worldwide, DFMA has become a vital design tool in their effort to compete in domestic and world markets. The data collected from published literature on over 50 case studies conducted by McDonnell Douglas at its St. Louis plant, outlines the power of the DFMA methodology. Some of the results are: reduction in manufacturing cycle time, part count reduction, part cost reduction; time-to-market improvements; quality and reliability improvements; reduction in assembly time. According to Geoffrey Boothroyd, Professor of Industrial and Manufacturing at the University of Rhode Island, the practices now known as Design for Assembly (DFA), and Design for Manufacture (DFM) had their start in the late 1970's at the University of Massachusetts. Of all the issues to consider, industry was most interested in Design for Assembly.

When developing a product, the maximum potential cannot be achieved without considering all phases of the design and manufacturing cycle. DFMA meets this demand by addressing key assembly factors before the product goes on to the prototype stage. These key factors are the product appearance, type, the number of parts required in the product, and the required assembly motions and processes.

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2.1.1 Design for Assembly

The research on DFA is pioneered by Boothroyd and Dewhurst and is based on the premise that the lowest assembly cost can be achieved by designing a product in such a way that it can be economically assembled by the most appropriate assembly system. There are three basic types of assembly systems, namely, manual, special-purpose machine, and programmable machine assembly. Boothroyd and Dewhurst provided a Product Design for Assembly Handbook indicating ratings for each part in the assembly, based on the part's ease of handling and insertion. The techniques described in this handbook are concerned with minimizing the cost of assembly within the constraints imposed by the other design features of the product. Using the DFA computer program provided, a designer answers a series of questions about the fastening method, symmetry of the parts, size of the parts, and angle of insertion. The evaluation obtained in terms of assembly time and assembly efficiency can be used to reveal the required design changes from the viewpoint of assembly.

The DFA method developed by Boothroyd and Dewhurst is summarized as follows:

i. Through the use of basic criteria, the existence of each separate part is questioned and the designer is required to provide the reasons why the part cannot be eliminated or combined with others.
ii. The actual assembly time is estimated using a database of real-time standards developed specifically for the purpose.
iii. A DFA index (design efficiency) is obtained by comparing to the actual assembly time.
iv. Assembly difficulties are identified which may lead to manufacturing and quality problems.

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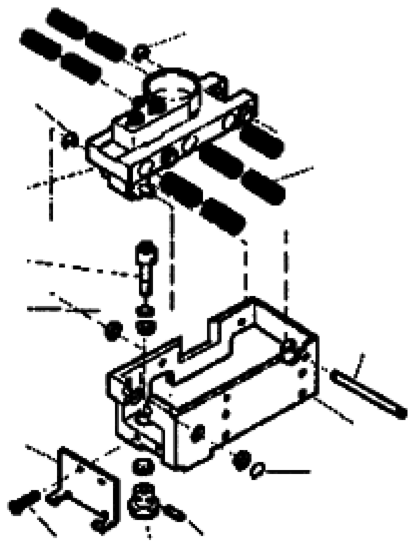

Figure 2.1: Traditional Reticle Design
(Boothroyd and Dewhurst, 1980)

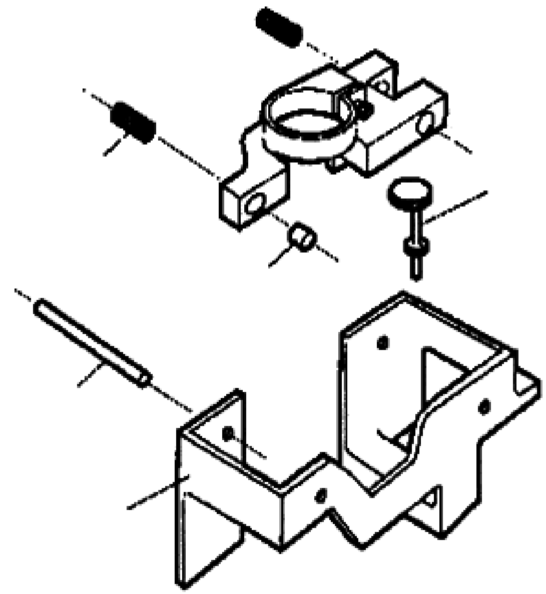

Figure 2.2: Reticle Design Using DFA
(Boothroyd and Dewhurst, 1980)

In the assembly, two factors that influence the assembly cost of a product or subassembly:

i. The total number of parts, and

ii. The ease of handling, insertion, and fastening of the part.

Therefore, in the DFA method, the basic alternatives for the designer to reduce the cost of assembly are either to avoid certain assembly operations altogether or to simplify them. Figure. 2.1 and 2.2 shows the comparison of a reticle design using a non-DFA method (Figure. 2.1) and the other using a DFA method (Figure. 2.2). It is evident that a DFA method provides numerous guidelines to reduce the number of parts. Warnecke and Bassler (1981) developed an approach called Assembly-Oriented Product Design. The authors assessed each part's usefulness or functional value to evaluate the combined rating. This means that parts which have little functional value, such as separate fasteners, and which are difficult to assemble are given the lowest ratings. Finally, the ratings are used as guidelines to redesign the products. Poli & Knight (1982) developed

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a spreadsheet approach to rating design on the basis of their ease for automatic assembly. The results showed those parts and product features that tend to increase assembly costs. Myers (1983) described an algorithm that computed the manual handling time of the various components using Boothroyd's (1980) theory and data. In this work, the features needed are extracted from solid model boundary representations. Scarr (1983) emphasized the need to provide the information on a CAD-based workstation. The author concentrated on developing design rules for which automated assembly and robotics assembly techniques are appropriate.

The following is a list of DFA criteria:

i. Minimize the number of (a) parts and fixings, (b) design variants, (c) assembly movements, and (d) assembly directions.

ii. Provide (a) suitable lead-in chamfers, (b) automatic alignment, (c) easy access for locating surfaces, (d) symmetrical parts, or exaggerate asymmetry, and (e) simple handling and transportation.

iii. Avoid (a) visual obstructions, (b) simultaneous fitting operations, (c) parts which will tangle or `nest', (d) adjustments which affect prior adjustments, and (e) the possibility of assembly errors.

Another issue in the Design for Manufacture (DFM) is the modularity design. Given a family of modular products, designing low cost assembly systems is an important problem. The ability to produce a variety of products through the combination of modular components is a meaningful benefit during product design stage. Therefore, modularity design is to produce different products by combining standard components and sharing the same assembly operations for a part of their structure. Several modularity designs have been extensively researched recently to reduce the delay of product development. The independence of functional requirements allows design parameters to have a controllable effect on a specific functional requirement and minimal negative impact on other functional requirements. Pahl and Beitz (1984) provided two modules from the aspects of technology development and production capacity,

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