DESIGN IMPROVEMENT ON A PRODUCT USING DFMA: INDUSTRIAL MACHINERY

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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ABSTRACT

DFMA (Design for manufacture and assembly) method is one of the development fields that can produce high efficiency product by using Boothroyd Dewhurst software. The machinery product for this research is T8 pneumatic pump that are built with plastic material. This product was analyzed by DFMA method to reduce the parts assembly and cycle time with the DFA tool analysis. This project also aims to show the low cost of manufacture in order to obtain the suitable process and material with the DFM tool analysis. Through this analysis, research on the current design and standard dimension for T8 diaphragm pump was done by using Solid Work software. A series of analysis been performed on 4 type of new T8 pump design according to the suggestion of original analysis. Selections of the new improvise design from 4 proposing pump will be done by using the D.O.E technique. From this method each of this pump are categorized by its design and analyzed again by the same DFMA software. Finally, choose the best design of high index efficiency and low time assembly. The related tables and charts can be practically used for comparison on current and improvise pump, the chosen of improvise pump shows 14.8 of index efficiency that more than the original pump which is 7.8. And time for assembly pump are less and quicker for the improvise pump which shows 40% faster than the original pump. For the DFM analysis, term of low cost show that improvised pump was 45% was cheaper than the original T8 pump. And through the DFM tool, polypropylene was the suitable material for manufacturing purpose.
DFMA (Rekabentuk pemasangan dan pembuatan) adalah salah satu medan peneraju untuk membuat produk baru dengan efisensi yang tinggi dengan menggunakan perisian boothroyd dan Dewhurst. Mesin produk yang dikaji adalah T8 pam omboh yang diperbuat daripada bahan plastik. Produk ini dianalisis dengan menggunakan cara DFMA untuk mengurangkan pemasangan komponen dan kitaran masa dengan DFA analisis. Projek ini juga menfokuskan pengurangan kos untuk pembuatan bagi mendapatkan bahan dan proses yang bersesuaian dengan DFM analisis. Menerusi analisis ini, kajian di dalam reka bentuk dan ukuran T8 pam omboh yang asal dilakukan dengan menggunakan perisian Solid work. Siri analisis dilakukan untuk 4 jenis pam T8 reka bentuk yang baru dengan merujuk cadangan pengubahsuaian analisis. Pemilihan salah satu reka bentuk T8 pam yang baru dari pada 4 pam yang dicadangkan tadi dilakukan dengan menggunakan teknik D.O.E. Daripada cara ini, setiap pam akan dikategorikan dengan reka bentuk masing-masing dan dianalisis sekali lagi dengan menggunakan perisian DFMA. Dan pilih reka bentuk yang mempunyai index efisensi yang tinggi dan masa pemasangan yang sikit. Carta dan jadual boleh diguna untuk mempraktikkan perbandingan untuk pam asal dan pam yang telah dipilih, index efisensi bagi pam yang dipilih menunjukkan nilai 14.8 yang lebih tinggi daripada pam asalan iaitu 7.8. Dan masa bagi pemasangan pam adalah minima dan lebih cepat bagi pam yang telah diubah iaitu 40% lebih laju daripada pam asalan iaitu. Bagi analisis DFM, istilah harga bahan yang rendah menunjukkan pam yang digubah adalah bernilai 45% yang mana lebih murah daripada pam asal. Dengan menggunakan DFM, propylene merupakan bahan yang sesuai dengan tujuan pembuatan.
DEDICATION

Specially dedicated to my beloved father, Rudy Abdullah and my mother, Dayangku Siti Faridah and who are very concerns, understanding patient and supporting, thank you for everything to my supervisors, En. Zolkarnain Marjom, my sisters, brother and all my friends. The work and success will never be achieved without all of you.
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<tr>
<td>BD</td>
<td>Boothroyd Dewhurst</td>
</tr>
<tr>
<td>CAD</td>
<td>Computer Aided Design</td>
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<tr>
<td>CAD/CAM</td>
<td>Computer Aided Design/ Computer Aided Manufacturing</td>
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<td>CATIA</td>
<td>Computer Aided Three Dimensional Interactive Application</td>
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<td>Concurrent Engineering</td>
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<td>Design for Assembly</td>
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<td>Design for Manufacture</td>
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<td>LNG</td>
<td>Liquefied Natural Gases</td>
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<td>PP</td>
<td>Polypropylene</td>
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<td>PS</td>
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CHAPTER 1
INTRODUCTION

1.1 Backgrounds

In the industrial revolution, the manufacturing industry has been pursuing more intentionally on design and processing sector. Into this, learning from the automotive and aerospace which shows the higher level of technology that have give the understanding about the manufacturing operation and contribute to higher production of product at any industrial sector. The current trend is to incorporate this two manufacturing basic flow into one technique approach which will influence the product to be developed are more cost savings, with quality improvement, reduce lead time assembly and giving a short time to enter the market.

One of the techniques is using the DFMA methodology. The aim of DFMA is to maximize the use of manufacturing processes and minimize the number of components in an assembly or product (K.L. Edwards, 2002). The Boothroyd & Dewhurst DFMA system not just only gives the reduction in part count but also contribute the save labor, inventory, floor space, documentation and administration (Bettles, 1999). The DFMA can be done by two methods which is either the manual way or by the teamwork (concurrent engineering) among the engineer and working on with the different course of department which concentrate in develop of one target product. Boothroyd Dewhurst software is one the alternative tool design that will be used in managing the product development process on this report.
1.2 Problem statement

The role of DFMA in optimization of design efficiency, assembly and manufacturing has received much attention from many organizations. This new technique approach has been successfully proved by the industry such as Hitachi, Ford motor company and so on which shows capable in resolving the problem occur in their product. It have become the tool in identifying the part damage and the part which need to improvise, (K.L. Edwards, 2002).

In this project, a case study was carried out at the Liquefied Natural Gases (LNG) Petronas Plant which located at Bintulu Sarawak. The problem occurs when so much time to overhaul or making maintenance to this pump. This is because the pump consist many complicated part to be disassemble and assemble. Other problem occurs when two integrated parts of this pump shown the leakage water. This problem occur when the clamping part not secured tightly and resulted the low stabilize operative machine. To resolve this matter, this parts need to been replaced by the spay part, in the certain time this part will once again be broken. Not just only that, error that happen to this pump will affecting to the other connection machine and give troublesome for the worker to repair it.

The troubleshooting on the problem statement as the above are rely on:

a) Strength of two assembly part where from the DFMA methodology, this two part can be combine into one functionally part.

b) The unsuitable material where this matter should consider used the fundamental material with the other part component.

c) Old design in which the part assembles will giving the low efficiency and should be concentrating on its data of design efficiency.
1.3 Project Objectives

The aim of this project was to determine the product efficiency, maintenance and new design of drawing by employing the DFMA methodology and analyze it with the aids of DFMA Boothroyd software.

The specific objectives that will be discussed on analysis and discussion parts are as follows:

a) Propose several improvement designs by D.O.E method.

b) Increase the index efficiency.

c) Reduce the cycle time of the assembly process.

d) Suggest new material for improvement design to reduce the manufacturing cost.
1.4 Scope of project

In this project, a diaphragm pump will be analyzed using the DFMA software. The part to be studied shown as figure 1.1 below:

By using the DFA methodology, the part design from the above will be analyzed and simplified in its structure number of part. To simplify its design, this product can be easily to handle, insert and contain fewer number of necessity part. Thus, the final product will shows the fundamental of time for assembly and the index efficiency for the new design. While for the DFM area, it will shows the fundamental of material and cost estimate at the end of this project.
1.5 Outline Chapter

Chapter 1
In chapter 1, the report are detailing on definition of manufacturing design for assembly and design for manufacturing (DFMA), problem statement, targeting objective and the scope of project.

Chapter 2
In chapter 2, this stage will include the chosen journal. The scope will focus on the literature review of DFMA and the introduction of the diaphragm pump machine as the project proposal in PSM.

Chapter 3
In chapter 3, the outline will focus on the methodology method that include in this project.

Chapter 4
This chapter will outline the analysis and discussion of the pump machine base on material uses, procedure assembly that will be adopt by DFMA software. The second segment will show the technical drawing by the use of Solidwork software.

Chapter 5
In this chapter, final conclusion and recommendation work will be utilized.
CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

These chapters describe about the entire important element that is considered in the project and also describe the type of product proposal that will be discussed on the next chapter. All methods about related DFMA will be demonstrated in this chapter.

2.2 Overview of DFMA

Design for Manufacture and Assembly, or DFMA as it has become to be known, is now a widely accepted technique which this methodology can be found mostly use in the sector of manufacturing, automotive, and electrical industry. These new techniques have become the basic tool in the product improvement, (K.L Edward, 2002).

According to Luo T. H. et al., (2007), DFMA is a methodology, which goals are to develop the integration between design and manufacturing, to shorten lead time, to cut down product developing cycle, to decrease the product cost, to improve product quality and reliability, to increase productivity and to response quicker to customer requirements. DFMA is a systematic procedure for analyzing proposed designs from the perspective of assembly processes.
During new product development, combination team of engineers and management (mechanical engineer, electrical engineer, production engineer, sale people and management) to generate the product, has proven to lower the product cost, improve product quality and decrease the development time, (Boothroyd, G. et al., 2002).

From the design point of the view, DFMA can be comprised by 2 means, which is DFA (Design for Assembly) & DFM (Design for Manufacture). Design for Manufacture (DFM) is a systematic procedure to maximize the use of manufacturing processes in the design of components and Design for Assembly (DFA) is a systematic procedure to maximize the components of the design product to be effective in its efficiency design, the procedures are often combined as Design for Manufacture and Assembly (DFMA).