UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN IMPROVEMENT OF SOLAR GRASS CUTTER USING DFMA METHODOLOGY

Thesis 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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2011

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PSM

TAJUK: **Design Improvement Of Solar Grass Cutter Using DFMA Methodology**

SESI PENGAJIAN: **2010/11 Semester 2**

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfilment of the requirement for the degree of Bachelor of Manufacturing Engineering (Manufacturing Design) with Honours. The member of the supervisory committee is as follow:

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ABSTRACT

This project describe about the implementation of redesign the solar grass cutter by using the application of Design for Manufacturing and Assembly (DFMA) methodology. The scope based on the existing solar grass cutter and the appropriate of DFMA methodology. The method used for gaining the data is from the resembled the existing solar grass cutter. From the data achieved, it can be classified into several categories to be studied. Data would be analyzed by using Lucas Hull method to verify the design efficiency, handling ratio and fitting ratio to achieve. The tools that used is TeamSET software. The new proposed design of solar grass cutter drawn by using SolidWorks software based on TeamSET result achieved. Result shown that the design efficiency for new design solar grass cutter obtained better percentage rather than the existing design. From the study, the total part, handling ratio, fitting ratio and cost of existing design is reduced. Eventually, the improvement of new design solar grass cutter finally will be able to meet user requirements and satisfactions.

ABSTRAK

Projek ini menghuraikan tentang pelaksanaan dalam mereka bentuk semula mesin pemotong rumput solar dengan menggunakan aplikasi perisian DFMA (Design for Manufacturing and Assembly). Skop projek adalah memfokuskan mesin pemotong rumput solar yang sedia ada dan sesuai dengan kaedah DFMA. Kaedah yang di gunakan untuk memperoleh data ialah dengan menganalisis mesin pemotong rumput solar yang sedia ada. Data yang diperoleh dapat diklasifikasikan ke dalam beberapa kategori untuk dikaji. Data dianalisis dengan menggunakan kaedah Lucas Hull bagi menentukan kecekapan reka bentuk, nisbah pengendalian dan nisbah perhimpunan sebagai pencapaian objektif projek. Perkakas perisian yang digunakan ialah perisian TeamSET. Reka bentuk mesin pemotong rumput baru di lukis dengan menggunakan perisian SolidWorks berdasarkan hasil yang didapati dari analisis TeamSET. Keputusan yang di peroleh membuktikan yang kecekapan reka bentuk untuk mesin pemotong rumput yang direka bentuk semula memperolehi peratusan lebih baik daripada reka bentuk yang sedia ada. Daripada kajian itu, jumlah bahagian, nisbah pengendalian, nisbah perhimpunan dan kos reka bentuk juga dapat dikurangkan. Akhirnya, peningkatan mesin pemotong rumput baru ini dapat memenuhi keperluan dan kepuasan pengguna.

DEDICATION

To my beloved Mum

Rahimah Binti Abdul Rahman

To my beloved wife

Hasaniah Binti Yahya

For the rest of the families, my brothers and sisters,

Thanks for your encouragement, support and motivation.

ACKNOWLEDGEMENTS

Bismillahirrahmaanirrahiim…

Alhamdullilah, grateful to Allah for giving me the strength to finish this final year project completely beside gaining valuable experiences and knowledge throughout completing this thesis, this experiences and knowledge may assist me to develop my personal skill in the future.

Special thanks are addressed to my supervisor, En Taufik for his guidance, advices, idea, and his patience to me in accomplishing this project, a special debt of gratitude towards him. To my beloved mother, brothers and sisters, and my wife, thank you so much. Without their continue support and encouragement, I could not have gone further than where I have. Not forgetting En. Zolkarnain Bin Marjom and my friends for their help, co-operation, opinion and advice.

Lastly to the names that I forgot to mention, you know who you are, thank you so much from the bottom of my heart.

May Allah repay all your kindness…

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DFMA	Design of Manufacturing and Assembly
DFA	Design for Assembly
PSM	Projek Sarjana Muda
SPC	Stastical Process Control

CHAPTER 1
INTRODUCTION

1.1 Project Background

Grass cutter machine can easily found everywhere in hardware shop with reasonable price. The grass cutter machine is requiring for some private residence in housing area was having landscape in the house. The modern design creates the machine grass cutter which is safer than ever before to be used in private residential.

Today, there are many machine grass cutter in the market. But it still can be improved or redesign especially from ergonomic point of view. It is because some of the characteristics are not suitable for objective use in area industry like blade shape and material of blade, economic factor like currently was use the fuel, movement limited for used electricity, and not flexible. Therefore, this is a new proposal idea of a machine grass cutter where it was applied the ergonomics design concept which is cover the ergonomic aspects like safety, user friendly in term of functional, cost and the specially was used the solar energy was generated by solar panel as a source of power replacement the petrol like currently grass cutter machine at the market.

This project will apply the Design for Manufacturing and Assembly (DFMA) methodology. Therefore, one of the DFMA approaches, Lucas Hull DFA are implemented in order to improved the product development process and reduces manufacturing cost. It is because a lot of cost involved in manufacturing and assembly of a product.

A significant part of this cost can be attributed to the labour intensive activities associated with assembly. Therefore that approach is used by the design team in simplifying the product structure, reduce assembly cost and time and to quantify improvements. This report is more focus to one type of landscape appliance which is a Solar Grass Cutter.

1.2 Problem Statements

Lately, we usually see the grass cutter machine was used at the housing park and residence bungalow. The commercial area like industry area, we usually see the manually and conversional method was used grass cutter machine was use the fuel as source power. The costing of maintenance for fuel was increase by the current price of fuel was increase at same time. Otherwise, many accidents happened to operator was used the machine like the blade of machine was regardless from machine. Thus, this case study project will be focusing on grass machine cutter was use alternative source of power like solar energy to replacement the fuel as the source of power. In addition, the modification will be do to the blade use the friendly user material and not hazard to the operator of the machine. One more thing is the price of the machine was currently at market too expensive, hopefully with the redesign was use software TeamSET will be reduce the part not necessary and will reduce the production cost and same time the price of the machine will be more cheapest compare current market.

1.3 Objectives of the Project:

The objectives of this project are:

1. To study design parameter of solar grass cutter
2. To analyze the solar grass cutter machine using DFMA methodology
3. To design the solar grass cutter machine.

1.4 Scopes of Project:

It is a project limitation or project area where this project will be focusing on which is to ensure that the project is not run out and still in project scopes. Below are the scopes of the project:-

(a) Analyze and review the existing product in order to identify the advantages and disadvantages of the current design of a machine grass cutter and propose the new design based on design efficiency by use Lucas Hull (Team set) software.
(b) Implement the Lucas Hull software (Team set) to improve the design efficiency
(c) The software solid work will be use to design the product.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

A literature review is one of the research methods to review the previous history in order to get the idea, project concept development, project methods and so on. A literature review is one of the mechanisms for our references to grab and get more knowledge about some research or product or what else that has done by previous researcher. It viewed the scientific process and concept based on their experimental. Usually, it comes out like journal, books, article and so on. The component of literature review is the actual research where they use the fact and logical concept that nobody can argue their research.

This chapter will explain the design for assembly and manufacturing (DFMA) concept and the drives for industries to implement DFMA concept. They are global market changes and consequences of component oriented design. However, one of the DFMA method, Lucas -Hull only mentioned in this chapter and is implemented throughout this project.

2.2 Designs for Assembly (DFA) Overview

Design for assembly (DFA) is an approach to minimize assembly cost and time by reducing the number of parts or simplify the product. The application of DFA usually brings consequences to product quality and reliability improvement and reduction of production part and inventory. Those consequences are also the factors of reduced assembly cost. According to Chan and Filippo (2005), DFA can be defined as; *A product design improvement processes for convenient and low cost assembly that focusing on functionality and assembly.*

There are three best known and also the most well documented DFA method. They are the Boothroyd –Dewhurst System, The Lucas DFA Method and the Hitachi Assemilability Evaluation Method (AEM). In general, the designer is guided through the analyses, which are presented in a series of assessment charts. The charts are based on empirical data gathered by knowledge engineering exercise with industrial expert and organised in an easy –to-use worksheet format.

During the evaluation, the designer is required to ass‘s component functionality, form, manufacturing processes and assembly characteristic using value extracted from the charts according to component properties. These numbers are then compiled in tabular format, and calculation performed. In this way, the designer is able to quantify the suitability of the design (www.eng.hull.ac.uk).The Lucas DFA methodology has been chosen for use within this project because of available facility within UTeM and there are some circumstances found within the other two.

2.3 Drives for DFA Implementation

There are identified two major factors that lead the industries or the companies started to implement DFA.They are global market changes and requirement of proper or convenient assembly in order to raise the rate of delivery to customer and also to improve product development and cost.

2.3.1 Global market changes

The competitive nature of the international market place has led to short product lifecycles and reduced price margins. Therefore, methods to improve the product development processes and reduce cost required. It is because a lot of cost involved in manufacturing and assembly of a product. A significant part of this cost can be attributed to the labour intensive activities associated with the assembly. Therefore DFA method is used by the design team in simplifying the product structure, reduce assembly cost and time and to quantify improvements.(www.eng.hull.ac.uk).

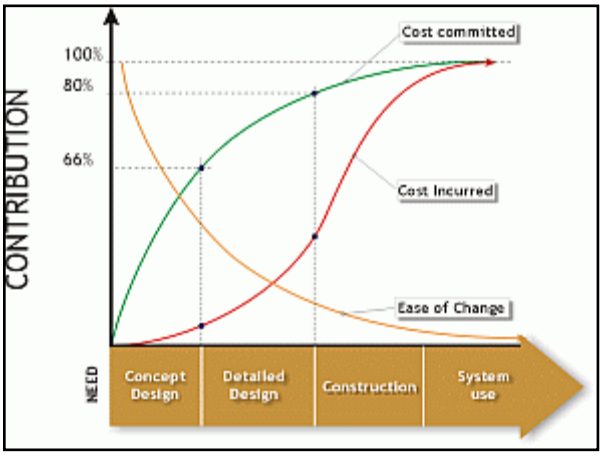

Figure 2.1: Design Changes vs. Cost (www.eng.hull.ac.uk).

2.3.2 Consequences of component oriented design

There has been a trend towards automated assembly in order to reduce labour costs. However, the potential benefits of automated assembly are limited by the need for flexibility and the ability to respond to product changes and short production runs whereby the most effective from of assembly is often manual assembly. Therefore, automated product assembly process is not necessarily the solution for reducing product development costs. (www.eng.hull.ac.uk).

In fact, the design process is the key to reduce product development costs. As shown in Figure 2.1, the overall product development costs are determined during the design stage which is approximately 80%. The high assembly costs are often due to an unnecessarily large number of components in the product and the complex manufacturing and assembly processes that are required due to the design of inappropriate component interfaces. Studies have shown that often, product is still designed with at least 50% excess of parts and greater assembly content than is necessary (www.eng.hull.ac.uk).

The poor design which caused by the designers who designed product according to their intuition highly contributed to assembly problem is still prevalent in many industries. Traditionally or the over the wall approach, different engineering departments perform design, planning and manufacture of the product with no integration or feedback and so assembly problem are identified only at the later stages of production .In order to reduce lead times and product cost effectively, manufacturing and assembly issues must be detected and considered during design or also known as concurrent engineering approach. This required the introduction of assembly –oriented design so that product development and assembly planning can be performed simultaneously rather than consecutively as referred to www.eng.hull.ac.uk(2003).

2.4 Assembly Methods and Processes

Mostly there are two types of basic assembly processes in industries today. They are those performed manually (human) and those performed by mechanism (automated).The comparison between assembly methods are shown in Figure 2.2 and Figure 2.3.

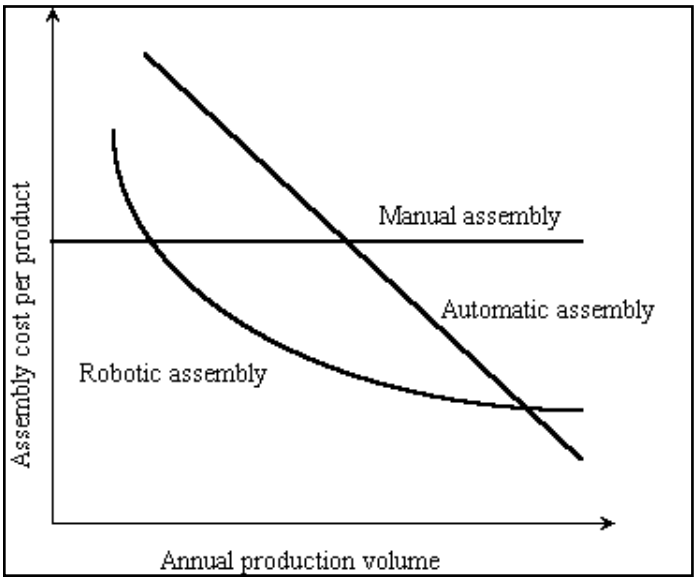

Figure 2.2: Cost comparison between different assembly methods relative with volume of production. (Chan and Filippo , 2005)

2.4.1 Manual assembly

In manual assembly, the parts are transferred from a workbench to another where the workers manually assemble the components into full product or each person responsible for the assembly of only a small portion of the complete unit. In doing this kind of assembly, tools such as screwdriver or any other assembly tools are essential in aiding the workers doing assembly. This kind of assembly is the most flexible and adaptable among the assembly methods. However, there are limit to the production secondary operation analysis may required on certain parts volume, and labour cost which include benefits, cases of workers compensation due to injury, overhead for maintaining a clean, and healthy environment are higher according,(Chan and Filippo,2005).

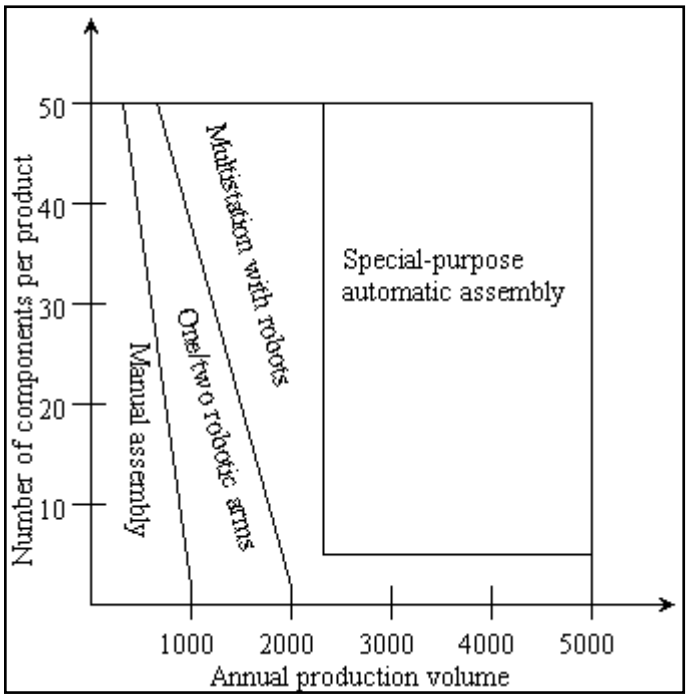

Figure 2.3: Annual production volume for each type assembled (Chan and Filippo, 2005)

2.4.2 Automated Assembly

The automated assembly generally divided to another two subcategories. They are Automatic (dedicated assembly) and Robotic (flexible assembly).The following are the elaboration of those assemblies.

2.4.2.1 Automatic /Dedicated Assembly.

The automated assembly is characteristic by custom built machinery that assembles one and only one specific product in which ignores multiple of same activities .The cost of machinery required for this kind of assembly involves large capital investment. As production volume increases, the fraction of the capital investment compared to the total manufacturing cost decreases (Chan and Filippo, 2005).