UNIVERSITI TEKNIKAL MALAYSIA MELAKA

REDESIGN OF NAIL CLIPPER THROUGH BD DESIGNFOR ASSEMBLY METHODOLOGY

Thesis submitted in accordance with the requirements of the Universiti Teknikal Malaysia Melaka for the Degree of Bachelor of Engineering Manufacturing (Engineering Material) with Honours.

By

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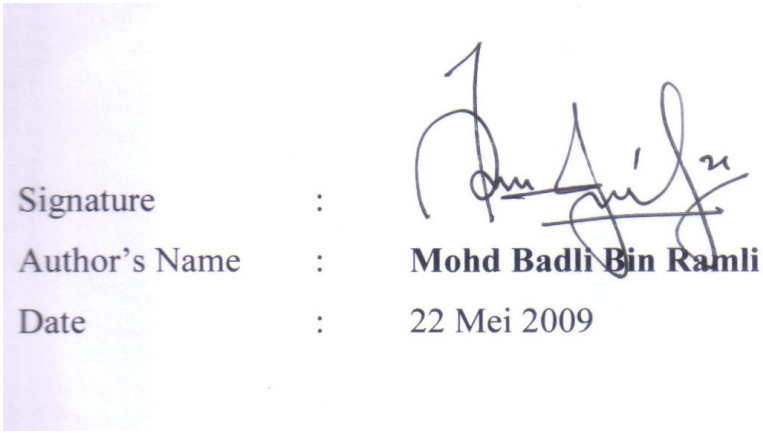

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APPROVAL

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 (*Material Engineering*). The members of the supervisory committee are as follow:

ABSTRACT

It is now widely accepted that the majority of the cost involved in assembly is determine at the earliest design stage. Although it is obviously important to keep assembly cost as low as possible, in this project, nail clipper is being chosen as a subject. The main objective is to reduce parts count, where it is a major influencing factor when considering the assembly efficiency. DFA method through Boothroyd Dewhurst (BD) Methodology is chosen because of well established technique for cost reduction at the design for manufacture interface. The DFA method starts with the analysis to rate each component on its ease of orientation and assembly of an existing nail clipper design. In the original design, six components need to be analyzed to optimize manufacturing cost. Through the methodology, the re-design helps to simplify the design and reduce the part count into three components. From the simplification approach, the cost estimation can be done. It predicts the cost of the product before a great deal of capital resources have been consumed in its design where in this case 50% of parts reduction will help tremendously. This explain the conceptual design using BD DFA helps to identify potential saving that manufacturing people need to be implemented especially in this economic downturn.

ABSTRAK

Telah terbukti pada masa kini, faktor penyumbang terbesar kepada peningkatan kos sesuatu produk bermula pada peringkat awal rekabentuk. Oleh itu, amatlah penting untuk memastikan kos pemasangan produk adalah pada tahap yang terendah. Dalam projek ini pemotong kuku (Nail Clipper) telah dipilih sebagai subjek. Objektif utama adalah untuk mengurangkan bilangan komponen pada sesuatu produk, dimana ia adalah faktor utama penyumbang kepada kecekapan sesuatu rekaan. "Design for Assembly" telah dipilih sebagai suatu kaedah untuk menganalisis sesuata rekaan, seterusnya mengurangkan bilangan komponen produk tersebut. Disini "Boothroyd Dewhurst Methodology (BD) " telah dipilih sebagai kaedah untuk melaksanakan projek ini kerana keberkesanannya dalam mengurangkan kos dan komponen. Kaedah ini bermula dengan menganalisis produk sedia ada dari segi bilangan komponen dan proses pemasangan dan kemudian diterjemahkan kepada bentuk matrik. Dengan mengunakan kaedah BD, analisa dapat dijalankan dengan cara penentuan setiap komponen dari segi kebolehan komponen untuk dikendalikan dan kebolehan pemasangan komponen-komponen pemotong kuku. Terdapat 6 komponen yang perlu dianalisa dalam pemotong kuku yang lama untuk mengurangkan kos pembuatan. Dalam mengurangkan bilangan komponen, kos penghasilannya dapat dikurangkan, oleh itu dijangka sebanyak 50% pengurangan komponen dapat dicapai di akhir kajian ini.Ini menunjukkan kelebihan kaedah BD dalam mengurangkan kos pengeluaran dan wajar dijalankan terutamanya ketika kegawatan ekonomi.

DEDICATION

To my beloved parents, especially to my mother Ba`ayah Bt Abdullah, to my supervisor Mr Ismail Abu Shah and all of my friends.

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بِسْمِ ٱللَّهِ ٱلرَّحْمَٰنِ ٱلرَّحِيمِ

In the name of Allah, The Beneficent, The Merciful.

Alhamdulillah, all praises to Him that I have been able to complete the first-semester final year project titled "Redesign Nail Clipper Through Design for Assembly Methodology". Highest appreciation and sincere gratitude regarded to the project supervisor, Mr. Ismail bin Abu Shah, for the guidance and attention in helping me to complete this final year project. Not forgotten to En Fadhil Muin Bin Hashim from Fujitsu Component (M) Sdn. Bhd. for giving a very good support in making the prototype. All comments given had urged me to struggle hard in fulfilling the required deliverables of the project. Utmost thanks family that support me a lots, especially to my mother Ba`ayah Bt. In addition, thanks to all my peers friends, for the continuous support and willingness to share their ideas regarding this project.

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LIST OF ABBREVIATIONS

BD	-	Boothroyd Dewhurst
DFMA	-	Design for manufacture and Assembly
DFA	-	Design for Assembly
DFM	-	Design for Manufacture
FEA	-	Finite Element Analysis
RP	-	Rapid Prototyping
3D	-	3 Dimension
2D	-	2 Dimension
UTeM	-	Universiti Teknikal Malaysia Melaka

CHAPTER 1
INTRODUCTION

1.0 Introduction

In this 1st chapter, the contents included the background, objective, scope and the problem statement of the research. In the problem statement, states the reason of the research done. For the objective of the research, it will state the aim of the research that will be done and limitation of the research will be stated in the scope of the research.

Current financial crisis has created especially for the industrial people to be more and more conscious in spending. One of the strategies to lower the manufacturing cost is through the product design. In general, a product design can dictates the manufacturing complexity as early as in the design stage. A product is developed from a construction of several parts and has gone through many processes to create a physical object that can performs a function or multi-function. These processes incurred cost particularly in this work, is emphasized on how to reduce cost through the assembly operation when the operational time of the assembly process can be quantified into cost as well. The design of a product itself relies on the part quantity to be assembled or known as part count. Part count is a major influencing factor when considering assembly efficiency. As the part count in a product increases, the more assembly time and assembly cost will be. As such, the assembly operation (including such aspects as the assembly time and assembly cost) can be evaluated early in the design process, with the potential for improving the design. Design for assembly (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.

Boothroyd Dewhurst (BD) DFA is one of the tools that can be used to improve the design without compromising the quality aspect and helps to lessen the assembly cost. Through BD DFA, it analyzes and evaluates product designs for ease of assembly. This tool guides the design team to drive the manufacturing cost by focusing on part count to achieve cost reduction through product simplification. It addresses assembly quality largely through product structure simplification and reduction in the total numbers of parts in a product . In the design simplification, the process of eliminating and combining parts are carried out properly in order to ease the assembly. Thus to improve a design by using the BD DFA method, nail clipper has been chosen as a product in this work to ease the assembly through the design simplification process.

1.1 Background of The Research

Assembly is more than putting parts together. Assembly is the capstone process in manufacturing, it brings together all the upstream process of design, engineering, manufacturing and logistics to create an object that performs a function. Many organizations have different method for establishing the critical issues in product design; as a result they will focus their efforts in designing. The use of such methods is often restricted to safety, quality, reliability and maintainability issue. There are many ways or technique that can be used for improving the original product. Design for Manufacturing and Assemble (DFMA) is the one of them, this methodology should be understand and explored before applying it into the original product. DFMA is divided into 2, which is Design for Manufacturing (DFM) and Design for Assembly (DFA). The term Design for Assembly (DFA) describe as an analysis method that was developed whereby designers could take assembly problems into account in the product design phase. Then, the design considerations were expanded to include Design for Manufacture (DFM) of the individual component parts of a product. In both cases, the terms were applied to the design of the product and not to the manufacturing process. The objectives were clear and the results outstanding. Applications of DFA resulted in simpler products with fewer parts, saving millions of dollars in manufacturing costs in many companies. There is few

popular assembly methods, such as Boothroyd-Dewhurst, Lucas and Hitachi assembly reliability Evaluation Method are the most well known assembly methods. In this thesis, Boothroyd-Dewhurst analysis is chosen as primary tools to undergo all the experiments that will be done.

1.2 Objective

To make sure that this research meets the goals and requirement, the objective of this work is to redesign the original nail clipper by creating new design feature with less part count and help to reduce the operational assembly cost using BD DFA method. In this case study, the work is only focused on the manual operation of assembly process. This is due to manual operation is the basic and most applied assembly process in the industries. Whereas BD DFA is used in the analysis to ease the assembly time and could estimate the reduction of the assembly cost as well.

1.3 Scope

The scope of this research is limited by only use the manual Boothroyd Dewhurst technique for design analysis and use the Autodesk Inventor profesional 2008 for 3D modeling & Redesign.

1.4 Problem Statements

Since beginning of the 19th century, the increasing need for finished goods in large quantities, especially in the armaments industries, has lead engineers to search for and develop new methods of manufacturing or production. As a result of developments in the various manufacturing process is now possible to mass produce high quality durable goods at low cost. In addition, now days the increasing of oil price had give a deep impact to the world. In the manufacturing process the increasing of oil price had affected the manufacturing production line, especially when producing various parts to make one complete product. If all manufacturing parts price increases, the more of parts being use to be assembled for one product simultaneously it will increase the price of that product. Although during the last few decades, effort have been made to reduce assembly costs by the application of high speed automation and more recently, by the use of assembly robots, success has been quite limited . Workers assembling mechanical product are still using the same basic tools as those employed at the time of the Industrial Revolution. To overcome the problem, design and manufacturing process simplification should be implement totally to reduce the burden on consumer. In this globalization era lean manufacturing is the main aims of each company, with that manufacturer will earn more profits and continuous mass production. With that reason, Redesign of Nail Clipper through Design for Assembly Approach has been suggested for the Final Year Project title. Where this research will reduce nail clipper parts counts, simpler the assembly process and redesign back the original nail clipper and improve the ergonomic factor of the new design nail clipper. This research also will define the component that can be reduce, improving the original product in aspect of cost and product assembly. With this final year project will shorten the cycle time, reduce the product variant, increase company profits and reduce cost without disturbing the quality issue.

1.5 Significance of the Study

In this new era of manufacturing globalization world, there are many ways to increase manufacturing productivity, by utilizing improved material, tools, processes, plan layout, and etc. Consideration of manufacturing and assembly during product design hold the greatest potential for significant reduction in production cost and increased productivity. In other words, if the product is poorly designed for assembly and manufacturing, too much time and money have already been expended in justifying the design to consider major changes or even a completely new design. Design for assembly (DFA) should be considered at all stage of the design process. Conceptualizes alternative solution and begins to realize their though on paper, it should give serious consideration to the ease of assembly of the product or subassembly during production and service. The Redesign of Nail Clipper gives better solution of current problem that exist all around the globe. The study is about the simplifying the original nail clipper design is the main component of this research accomplishment. Besides that, the manufacturing processes are needed to be sharpened in terms of its skill and understanding the design for assembly (DFA) as the main topic to be accomplished. In designing a good concept of prototype it is necessary to achieve the best perception of the evaluator at the end of the research. By applying DFA tool, communication between manufacturing and design engineering is improved, and ideas, reason and decision making during design process become well documented for future reference.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

In this chapter, it will mainly discuss about the general operation, principles and mechanisms that related to the Re- engineering of Nail Clipper through DFA methodology. Some of previous research and studies were included into this chapter to support the development of ideas for Re- engineering of Nail Clipper concept and design.

2.1 Comparison of DFA method

From the explanation about Hitachi AEM, Lucas and Boothroyd - Dewhurst, a potential user will intend to know which method best suit for a particular purpose. Table shows the rating of DFA methodology characteristic and table shows a comparison table for a variety of method and the following is the key to interpretation of the table. Shahriman,S.(2007)

Table 2.1: The rating of DFA Methodologies characteristic.

Rating method	Better (B)	Average (A)	Worse (W)
AEM	-teaches good practice -systematic -training and practice -Implementation cost effort		-Rapidly Effective -Designer Effort
Lucas	-systematic -rapid effective	- teaches good practice -training & practice -Implementation cost and effort	-Designer Effort
Boothroyd - Dewhurst	-teaches good practice -systematic -rapid effective	-training and practice -Implementation cost and effort	-Designer Effort

Table 2.2: Comparison table for DFA methodology (Redford and Chal, 1994)

Method Criteria	AEM	Lucas	Boothroyd
Training and practice	B	A	A
Implementation cost effort	B	A	A
Teaches good practice	B	A	B
Systematic	A	B	B
Rapidly effective	W	B	B
Rapidly effective	W	W	W

Description :

A=Average, B = Better , W= Worse.

- Training and practice- little or no training
- Implementation cost effort- merely a seminar of brief training required
- Teaches good practice- teaches good DFA practice reliant on method
- Systematic-involved step by step systematic procedure to ensure all relevant issues are considered
- Rapidly effective- like to be rapidly effective for brief training required
- Rapidly effective-little or no additional designer time or effort require for effective use

Approaches \ Categories	Assembly		Production volume			Size			Weight			Complexity					
	Manual	Automated	High	Medium	Low	Small	Medium	Large	Light	Medium	Heavy	High	Medium	Low	Standard parts	Variants	Assembly and manufacturing equipment
Hitachi		○	○			○			○					○			
Boothroyd and Dewhurst Inc.	○	○	○	○		○	○		○	○				○			
Lucas		○	○	○		○	○		○	○				○			
Li and Hwang		○	○	○		○	○		○	○				○			
Sturges and Kilani																	
Sturges and Yang																	
Wong and Sturges	○				○			○			○						
Kim, Bekey and Goldberg		○	○			○			○								
Holbrook	○			○	○	○	○		○	○				○	○	○	
Nazif				○											○		
Lee																	○
Brophy			○	○		○			○			○					
Fogg and Van		○	○			○			○						○		○
Molloy, Yang and Browne			○	○		○			○			○					○
Allen, Bielby and Swift		○				○			○					○			○
Redford		○															○
Malmqvist												○				○	

Table 2.3: Comparison DFA approaches summary. Gary Wallace and Peter Sackett (1996)