UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN ANALYSIS OF A BABY STROLLER BY USING DESIGN FOR MANUFACTURING AND ASSEMBLY METHOD (BOOTHROYD DEWHURST)

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree in Manufacturing Engineering Technology (Product Design) (Hons.)

by

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BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **Design Analysis of a Baby Stroller by Using Design for Manufacturing and Assembly Method (Boothroyd Dewhurst)**

SESI PENGAJIAN: **2014/15 Semester 2**

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology Product Design (Hons.). The member of the supervisory is as follow:

…….

(Project Supervisor)

ABSTRAK

Projek ini menggunakan kaedah rekabentuk untuk proses dan pemasangan supaya dapat mengkaji rekabentuk kereta sorong bayi (Sweet Cherry SCR 8 Series) dalam aspek pembuatan, proses pemasangan dan juga kepayahan ketika memegang dan memasang komponen. Masalah yang dikenal pasti dalam kajian ini adalah pada bentuk kereta sorong bayi yang banyak menggunakan screw pengikat dan juga penggunaan kedua-dua belah tangan untuk menggerakkan penyelak bagi melipat kereta sorong bayi tersebut. Objektif projek ini adalah untuk mengurangkan komponen disamping mengekalkan fungsi kereta sorong tersebut, untuk membuat perbezaan kadar kecekapan oleh rekabentuk asal berbanding dengan rekabentuk baru, dan juga untuk mengurangkan jumlah waktu pemasangan setelah analisis rekabentuk dan pemasangan dijalankan. Melalui kajian yang telah dijalankan, terbukti dengan menggunakan kaedah ini , kos pemasangan dapat dikurangkan sebanyak 452.29s, iaitu 23% lebih baik daripada yang sebelumnya. Kos untuk satu bahgian juga dapat dikurangkan sebanyak RM 33.41. Bilangan bahagian juga dapat dikurangkan daripada 179 bilangan kepada 149 bilangan sahaja. Indeks DFA juga meningkat daripada 9.6 kepada 12.6. Kelebihan penggunaan kaedah ini telah dibuktikan melaui rekabentuk baru untuk kereta sorong bayi

ABSTRACT

This project implemented the design for manufacturing and assembly (DFMA) methodology in order to study the design analysis of a baby stroller (Sweet Cherry SCR8 Series) in aspect of part for manufacturing, assembly process and also handling and insertion difficulties. The problem identified in this study is on the features of the stroller that shows a lot of fastener being used and also the usage of both hands in moving the fold latch to fold the stroller. The objectives of this project are to reduce part while maintaining the function of the baby stroller, to compare the efficiency of the original design and after redesign, and also to reduce total assembly time with a new product design of a baby stroller after DFMA analysis. The study has proven to save assembly time by 452.29s which is 23% more efficient than the original design. Further ado, the total cost per product for manufacturing has saved RM 33.41. The number of parts reduced from 179 parts to be 149 parts. The DFA index is also improved from 9.6 to 12.6. The advantages of using DFMA method has been proved in the redesign of the baby stroller.

DEDICATION

To my beloved parents and my brothers.

ACKNOWLEDGEMENT

First and foremost I offer my sincerest gratitude to my adorable supervisor, Madam Nurul Ain Binti Maidin, who has supported me throughout my project study with her patience and knowledge sharing. I attribute the level of my degree to her encouragement and effort and without this thesis, too, would not have been completed or written. One simply could not wish for a friendlier supervisor.

In my daily life I have been blessed with my beloved parent, Mr Ruslan Bin Mohd Dom and Mrs Kintan Binti Abdul Rahman. I owe them a deep sense of gratitude but not to forget with my handsome big brothers, Mr Ahmad Mohammad Bin Ruslan and also Mr Ahmad Muazzam Bin Ruslan that keep pushing me to success whenever I felt that I am not the best.

I thank profusely both of my roommates, Ms Khalilah Binti Khalid and also Ms Nurul Aima BintiMazlan for their kindness and co-operation throughout my study period.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

DFMA	=	Design for Manufacturing and Assembly
DFA	=	Design for Assembly
DFM	=	Design for Manufacturing
CAE	=	Computer Aided Engineering

CHAPTER 1
INTRODUCTION

Nowadays hundreds of stroller models are available with different branded and quality. This made the features of the stroller to be different and unique depends on the designer and company intention to be focused. However, the manufacturing process is the important things to be considered as it will affect the price of the product itself. Hence, this project focused on analyzing the design of a baby stroller in order to reduce cost then improve the manufacturing and assembly process with a new design of a baby stroller after the analysis. This chapter basically explain on how the project being made starting from the background study, problem statement, objective, scope, organization of the project, and lastly result expectations.

1.1 Background

Design for Manufacturer and Assembly in which being known as DFMA generally is a combination of Design for Assembly (DFA) and Design for Manufacturing (DFM). Through history of DFMA, it had been used before the Second World War by Ford and Chrysler that using DFM philosophy in their design and manufacturing process of the weapons, tanks and other military products. Early 1970's the researching job of this new technology had been done by Professors Peter Dewhurst and Geoffrey Boothroyd who originated the Boothroyd Dewhurst, Inc. (BDI) in 1983. Initially on comprehensive work studies, relating part characteristics to handling, fitting times and degrees of difficulties etc., their work was genesis of the concept of "scoring" designs for DFA or DFM. Currently Boothroyd Dewhurst methodology was the inspiration for many of its successors around the world.

In essence, unstructured DFA and DFM guidelines and rules are transformed into a structured form that can be applied using paper-based spreadsheet type analysis or computer software. For DFA, a formalized step-by-step process being used to produce a design metric that assesses the design efficiency related to its assemblability. The main steps involved are based on general DFA concepts in which choose assembly method (manual or automatic) analyze the design for ease of assembly and improve the design and reanalyze.

Boothroyd Dewhurst's, Inc. DFMA software is designed to be used at the concept design stage. The aim is to optimize design for manufacture and assembly before commitment to detail design and manufacture. The DFMA package contains a DFA module and DFM module.

Normally the DFA module is used first, working from a concept drawing. The aim is to improve design efficiency by eliminating of unnecessary parts, and choosing more efficient assembly methods. This is followed by DFA, which provides estimates of time and cost for assembly, as well as other operations. Through redesign, the design efficiency figure is improved. This provides a relative measure between design alternative which should influence the final design concept chosen. Meanwhile for DFM module is used to evaluate design alternative from a manufacturing cost perspective.

This project fundamentally focused on the design analysis of Sweet Cherry SCR 8 Series Stroller by implementing DFMA method. Hence, Boothroyd Dewhurst methodology had been used to complete this project.

1.2 Problem Statement

Nowadays, there are a lot of distinct process which all influence product cost, quality and productivity of system that cause a huge losses to Business Company. This is because a lot of product is made up of fasteners and redundant features (Othman, 2010). Boothroyd Dewhurst DFA method could help to overcome the problem by suggested the idle possible way to assemble a product with remove fastener. In a production of a baby stroller, from the features show a lot of fastener such as screw, rivet and many more as the structure need to be foldable. Hence, this project had analyzed the design for assembly to

reduce parts as well as the cost of production and come out with some improvement of the design in an efficient way.

1.3 Objective

(a) To reduce part while maintaining the function of the baby stroller.
(b) To investigate the efficiency of the original design and after redesign (comparison)
(c) To reduce total assembly time with a new product design (redesign) of baby stroller after DFMA analysis

1.4 Scope

In order to achieve the objective of the project, the scope had been list as shown below:

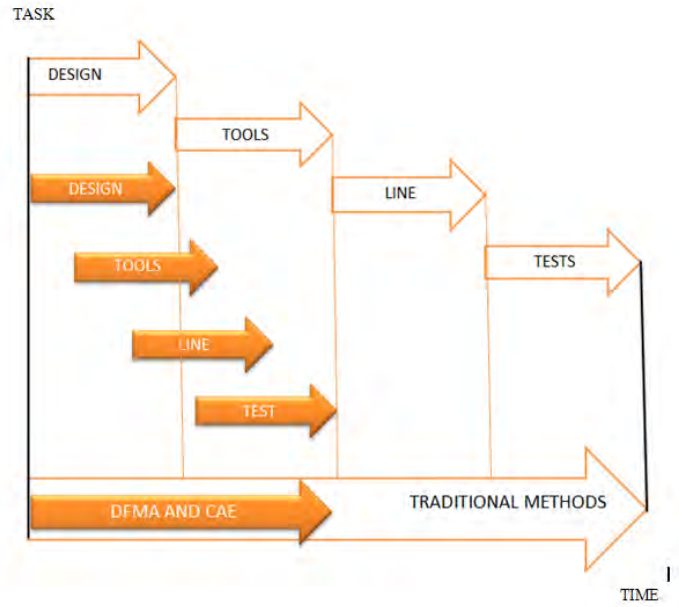
(a) Study of design for assembly of a baby stroller that focusing on mechanical parts only by using Boothroyd Dewhurst method.
(b) Evaluate a baby stroller as a case study, analyze and redesign the product using Boothroyd Dewhurst method.
(c) Solid Works software being used for drawing of each part and assemble of the original and redesign of the baby stroller.

CHAPTER 2
LITERATURE REVIEW

As the time flies an organizations need to learn in order to improve their adaptability and efficiency toward future. Through this idea with the help of new technologies and philosophies of compete with other competitors literally could enhance the development process with a good results to achieve target. Currently there are a lot of tools that could be used to help production team to solve their problem at an early stage. Hence, this chapter will review the past research from other sources with citation.

2.1 Designs for Manufacturing and Assembly (DFMA)

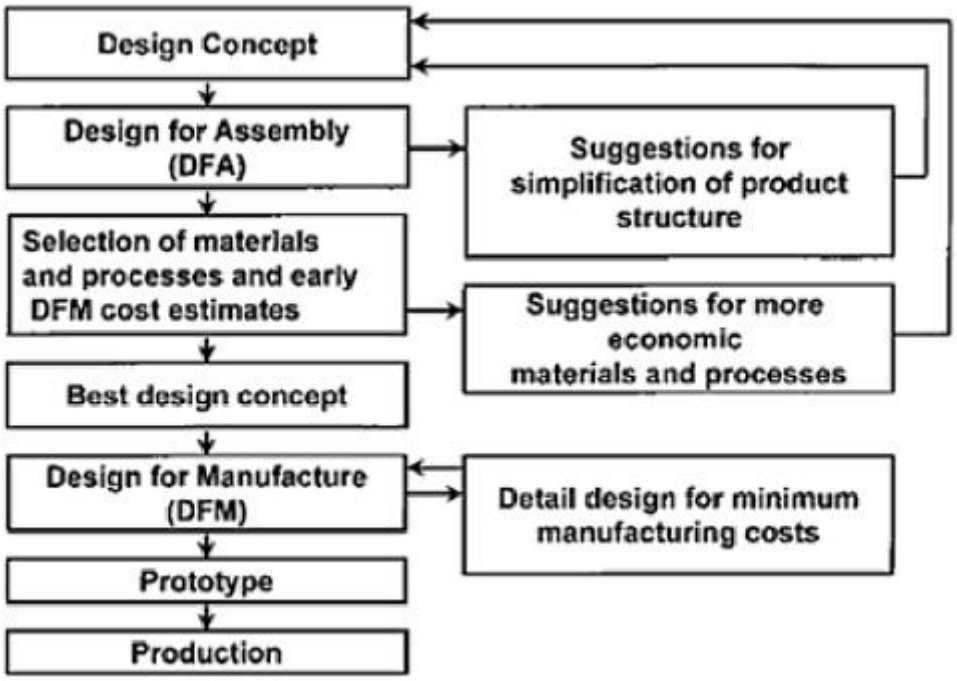
Design for Manufacturer and Assembly (DFMA) is a tool that helps in minimizing production cost by breaking the product down to be the simplest components and parts. Concurrent Engineering (CE) is intended to cause developers from the outset, to consider schedule, quality, cost, user demand and all elements of product cycle from conception to disposal. Both of this Production Oriented Design (DFMA and CE) could run activities simultaneously in a parallel form as being showed in Figure 2.1 below. They were using simulation techniques that could give a fully understanding among team member to find errors along the process and fix it before the development ends.



(Sources: Junior, O.C. at. all, 2009. The White Goods Part Designed Based on DFM/DFA Concepts in a Concurrent Engineering Environment)

Figure 2.1: Time to deliver comparison between DFMA and CAE with Traditional Methods

There are two major concept in DFMA process in which design for assembly (DFA) and also design for manufacturing (DFM). DFA is the design of the product for ease of assembly (Boothroyd, 1994). It is an analysis method that brings together multidisciplinary teams to evaluate and validate product design with respect to the manufacture and assembly of its components parts. Meanwhile DFM is to design that is based on reducing the cost of production and time to market for a product, while maintaining appropriate level of quality the material and tooling side of the new product. Hence, DFMA refers to working on both concepts together. Figure 2.2below shows the typical steps taken in DFMA study using DFMA software.



(Sources: Boothroyd,G., Dewhurst,P., and Knight, W., 2002. Product Design for Manufacturing and Assembly, 2nd Edition, Marcel Dekker Inc)

Figure 2.2: Typical steps taken in a DFMA study using DFMA software

DFMA can be used effectively to reduce part count in the assembly that brings to simplify the assembly process, lower manufacturing overhead cost, minimize assembly time, and improve quality by reducing the possibilities for introducing a defect. Also the amount of labor can be reduced once the component of parts becomes fewer and simpler assembly processes. When the part count had been reduced, automatically the development cycle become shortened as the philosophy encourages simplifying the design and using standardize component whenever possible.

2.2 Designs for Assembly (DFA)

Generally, there are two objective of DFA in which to minimize part count and to have remaining parts of a nature that they are easily assembled together. The DFA method accomplishes the objective by:

(a) Providing a tool for the designer and even design team which assures that considerations of product complexity and assembly take place at the earliest design stage. This eliminates the danger of focusing too much the whole things during early design on product function with insufficient regard for product cost and competitiveness.

(b) Guiding the designer to simplify the product so that the cost of assembly and parts can be saving equally.

(c) Gathering information normally possessed by the experienced design engineer and arranging it conveniently for use by less-experienced designers.

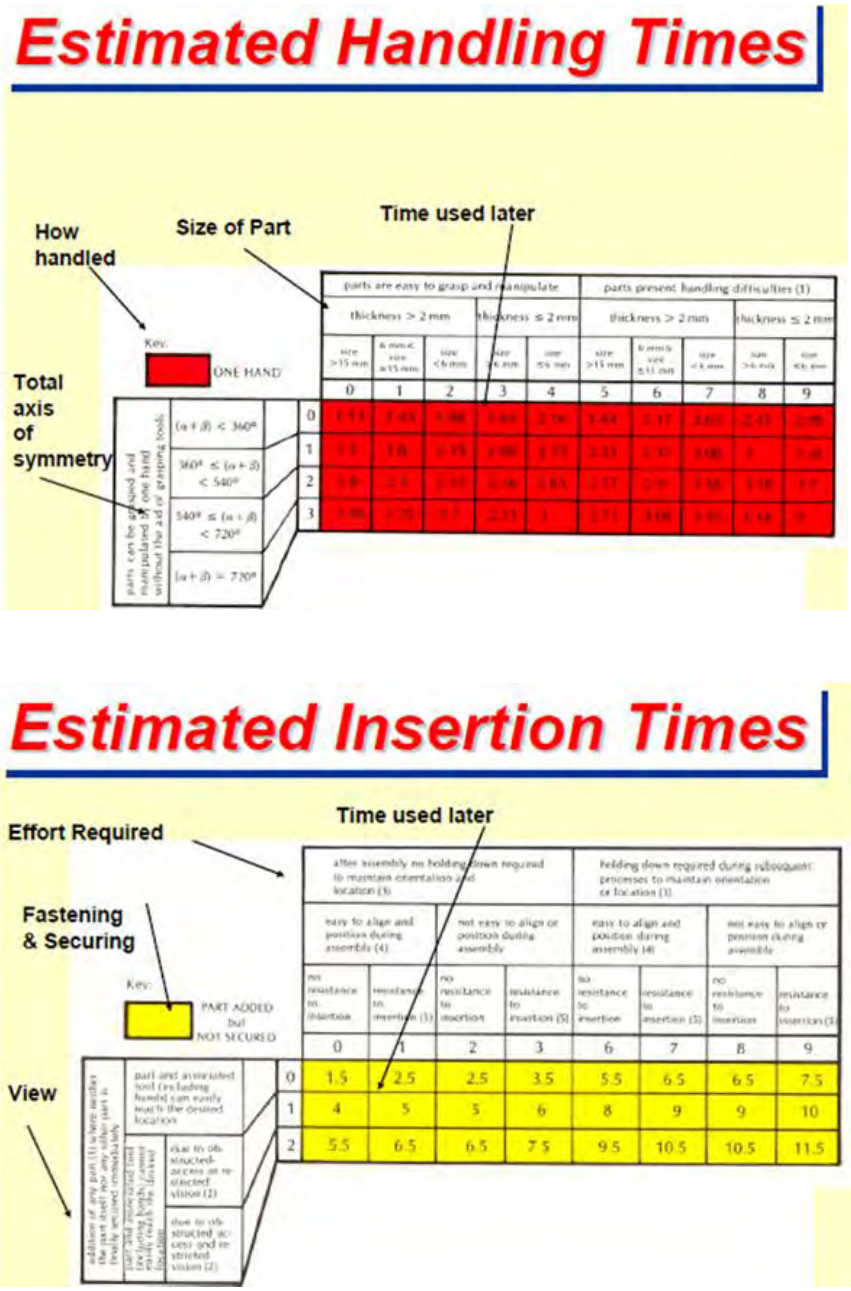
(d) Forming a database that comprises of assembly times and cost factors for numerous design situations and production conditions.

2.2.1 DFA Methods

The analysis of a product design for ease of assembly depends to a large extent on whether the product is to be assembled manually, fixed or hard automation, soft automation (robotic), or a combination of these.

(a) Manual assembly

List of parts are assigned to workbenches where the component of product being assemble manually by workers with the aids of hand tools. Even though this is an idle method for assembly, there is usually an upper limit to the production volume, and labor costs remain higher.



(Sources: Boothroyd,G., Dewhurst, P., and Knight, W.,2002. Product Design for Manufacturing and Assembly, 2nd Edition, Marcel Dekker Inc)

Figure 2.3: Manual Handling and Manual Insertion –Estimated Times