

DESIGN FOR MANUFACTURING AND ASSEMBLY (DFMA) OF INDUSTRY
PRODUCT


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ABSTRACT

The main purpose of the design for manufacturing and assembly is to simplify one product during manufacturing and assembly. The research of design for manufacturing and assembly (DFMA) has been undertaken a lot in the industrial field currently as it is potential in reducing a lot of time in develops the product. The applications of design for manufacturing and assembly (DFMA) also have widely been explored and many potentials field has been discovered for its usage. Boothroyd method is used to improve product design of a standing fan. The Boothroyd analysis concentrate on product handling and insertion until completely assemble. Analysis was done on each part to identify function, its weakness and strength of the product. After the design was improved on the analysis on the process and material selection was made. This is to find out the best materials and the suitable processes. Through this method a few concepts have been developed and the best concept have selected by consider the screening and scoring value. There were about 60 parts in the old product and it was reduce to 33 parts .This is reflected also in production. The number of operator was reduced 11 to 6. The result from the analysis shows that efficiency of the design is improved from 18 to 31.

ABSTRAK

Rekabentuk untuk pembuatan dan pemasangan adalah bertujuan untuk memudahkan produk dalam semasa proses pembuatan dan pemasangan. Kajian diatas rekabentuk untuk pembuatan dan pemasangan (DFMA) telah dibuat pada industry semasa dan ia sangat berpotensi dalam mengurangkan masa dan cost sesuatu produk. Kaedah ini telah dikai secara meluas dan ia terbukti dan sangat berguna. Kaedah Boothroyd digunakan untuk memperbaiki rekabentuk kipas berdiri yang telah saya pilih. Analisis Boothroyd memberi tumpuan kepada cara pengendalian dan pemasukan sesuatu komponen sehingga menjadi satu produk yang lengkap. Ia juga mengkaji tentang tentang fungsi ,kelemahan dan kekuatan dalam produk tersebut. Beberapa konsep telah dibuat untuk mendapatkan rekabentuk terbaik dengan mengambil kira nilai skrin dan skor. Analisis untuk proses dan pemilihan bahan dibuat selepas analisis rekabentuk siap dibina. Ia bertujuan untuk mencari bahan yang terbaik dan proses yang sesuai. Terdapat 60 komponen pada produk lama dan ia telah dikurangkan sehingga 33 komponen dan ia telah mempengaruhi susunan aliran pengeluaran pekerja .Terdapat 11 operater pada produk lama, ia menjadi 6 operater untuk produk baru. Hasil daripada analisis yang dilakukan kecekapan rekabentuk dipertingkatkan dari 13 peratus kepada 31 peratus.

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LIST OF ABBREVIATIONS

DFA	: Design for assembly
DFM	: Design for manufacturing
DFMA	: Design for manufacturing and assembly
AEM	: Assembly Evaluation Method
DSG	: Destructive solid Geometry
PAWs	: Producibility Assessment Worksheets
FBM	: Feature base model
TM	: operation time
CM	: operation cost
TH	: Handling time per item
TI	: Insertion time per item
TA	: Total operation time
CA	: Total operation cost

CHAPTER 1

INTRODUCTION

1.1 Background

Manufacture is process to build up the component part while the assembly is the way to join or add the part to produce a perfect product. Assembly will not approach the manufacturing process. Design for manufacturing (DFM) is to set ease style of manufacture. The collection of the part will generate the product after assembly and design for assembly DFA means the design of the product ease of assembly.

From there, many kind of method have been used to build that their product. Much of the early and significant work on DFM and DFA was done in the early 1970s .Product development was essentially done in several stages. The designer should have very good knowledge of materials and mechanisms. They must construct the prototype first. Once the prototype was tested and approved, the manufacturing team would then construct manufacturing plans for the product, including the tooling. Check out using the different material, thickness and also the different sheet material. They also must used different components example different sized screws to find the best way. Their goal was to achieve the same functionality, but make mass production more efficient. It is depend on manufacture engineer because it would effect some functional requirement.

The DFMA (*Design for manufacturing and assembly*) is also a setup of production line which designing for the process of manufacturing in the industry. The better performance of manufacturing process, the shorter line in every department, the safest cost reduction and safest time estimation resulted for the company. Soon, the product will probably manufacture faster than the existing product as the improve after implementing the DFMA approaches. (Boothroyd, 1991)

1.2 DFMA study

DFMA is The Design for Manufacture and Assembly. DFMA is combination from (DFA) Design For assembly and (DFM) design for manufacturing. This method is develop to build a perfect product while consider the manufacture and assembly.

There were detail design of the part and assemblies, part features, dimension and tolerance must be making neatly to get want important fact. A design engineer need a DFA tool to effectively analyze the ease of assembly of products and subassemblies of their design. This way should provide quick result and be simple and easy to use. It also should ensure consistency and completeness in its evolutions of product assembly. Product assimilability must consistency and completeness. A few thing should be consider eliminate subjective judgment from design assessment, allow free association of ideas, enable easy to comparison of alternate designs, ensure that solution make logically, identify assembly problem area and suggest alternate approaches for improving the manufacturing and assembly of product.

By using this DFMA tool it can develop communication between manufacturing and design engine, share new ideas, reasoning and from it will come out with good result. (Boothroyd, 1991)

1.3 Advantages

DFMA method serves many of advantage such as:

- Its make the production lines process more simple. There will less opportunity to make mistake in develop the product.
- Increases the quality of the product because it increase the reliability.
- By using the DFMA it will provide the systematic plan to do analysis about a product design from the point of view of manufacture and assembly. The result from of using this tool it will give a simpler and more reliable product which are less expensive to manufacture and assembly. Therefore there are no drawing and specification that is no needed after reduce part of the product. This will leave much important effect on overhead that in many cases larges proportional of the total cost effect of the product.
- Collaboration between the designer and the manufacturing will generate after the dialogue between them. Not enough the other individual also will take part from that and it will give more benefit of simultaneous or concurrent engineering can be achieved.

1.4 Objectives

The objective of this project is to:

- Analyse industry product (stand fan) using DFMA.
- Develop new design based on analysis made.
- The project is focusing on how to design the simplest structure of the product, so that it will ease manufacturing and assembly process.
- Relate to goal of the industry to reduce on manufacturing and assembly cost.

1.5 Scope of Study

The studies concentrate on DFMA of a study fan. The product has been disassembled and it have been assembled back to know the way of the insertion and handling. From that, we can find the time of insertion and handling. The design of the product also has been consider in order determining the best design. Concept scoring and the screening was used. In the manufacture analysis it is more on the selection material and the process of the product. \

1.5.1 Product review

There were many type of fan such as ceiling fan, wall fan, stand fan and ventilation fan. Most of this fan design of combination electrical and mechanical system. The standing fan that used in the study is shown in figure 1.1.

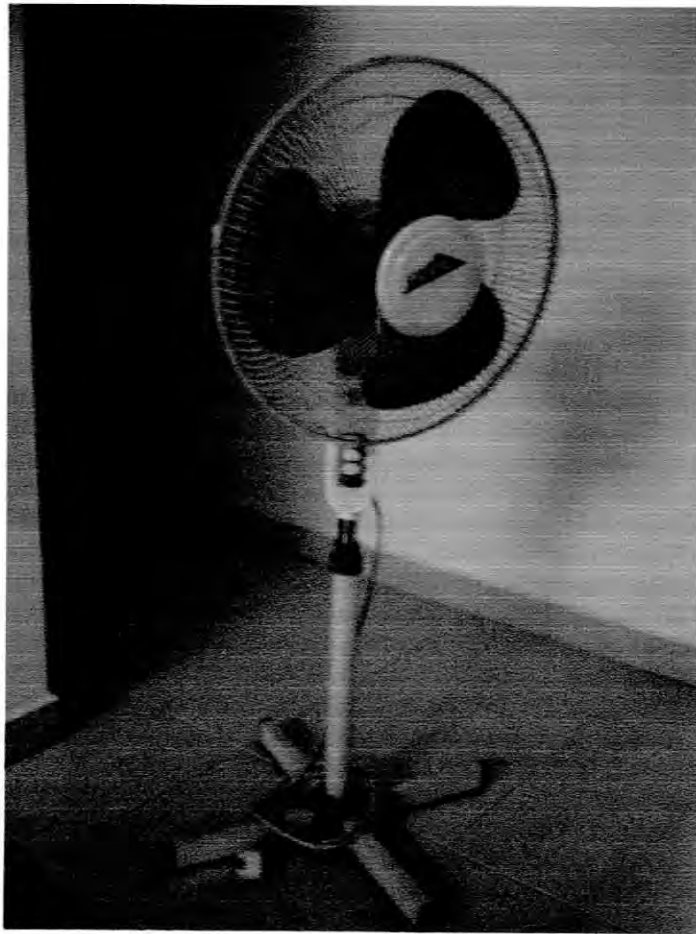


Figure 1.1: Stand fan

1.5.2 Stand Fan Assembly

Manual assembly used to assemble stand fan. Manual Assembly means that the process assembly used benches or simple conveyors. There were simple jigs and fixtures with manual clamping and simple, light tools (manual/pneumatic/electric screwdrivers, solder irons etc.).

For this product it almost used screwing tool, a few soldering, and snap clip. There were three section of assemble bottom, middle and upper. Bottom sections include the stand use to hold the fan. Control panel is the base part in the middle and it were assembles with upper and bottom section. The upper sections were a motor fan part. Combination of three sections develops complete stand fan.



Figure 1.2: Middle section assemblies of stand fan.



Figure 1.3: Assembly of middle and upper section.

CHAPTER 2

LITERATURE REVIEW

2.1 DFMA Method

This chapter, we will review methods in Design for Manufacturing and Assembly (DFMA). This method is to show us on how to deal with the existing product before analyze the product to propose a new conceptual design. There were many type of the DFMA method such as Taguchi, Hitachi, Lucas, Nippondenso, Taguchi and other. Here, they will produce a different style method according to their research. Although we find out it is the different method but the objective DFMA is still the same. They make an analysis on the data such as the parameters of materials, the functions of calculations of cost and cycle time, the components that can or cannot be assembled into the database of their software, and let the computer find out all the possible selections to a certain mission. By comparing all these results, an optimal plan is picked out and put into effect. From the result they use to simplify the product, reduce the manufacture cost and time of manufacturing and assembly.

2.2 Boothroyd and Dewhurst method

This method has been developing by two guys. The research was done in 1970. DFMA have being their company trademark. From this all research they apply to their company. The method can be used for manual assembly, with robotic assembly, and with machining.

Three shortcomings should be highlighted of DFMA method. (Boothroyd, 1990).

- The consider on all part in detail. By using the software, it would show the optimal plan and put into effect.
- The main target is not focus on the conceptual design stage, where most of the product cost is fixed.
- Is to provide redesign suggestions to modify shapes in the case of an unsuitable design

2.2.1 DFMA on controller assembly using Boothroyd and Dewhurst method

This controller has almost 20 parts before the method progress on it.

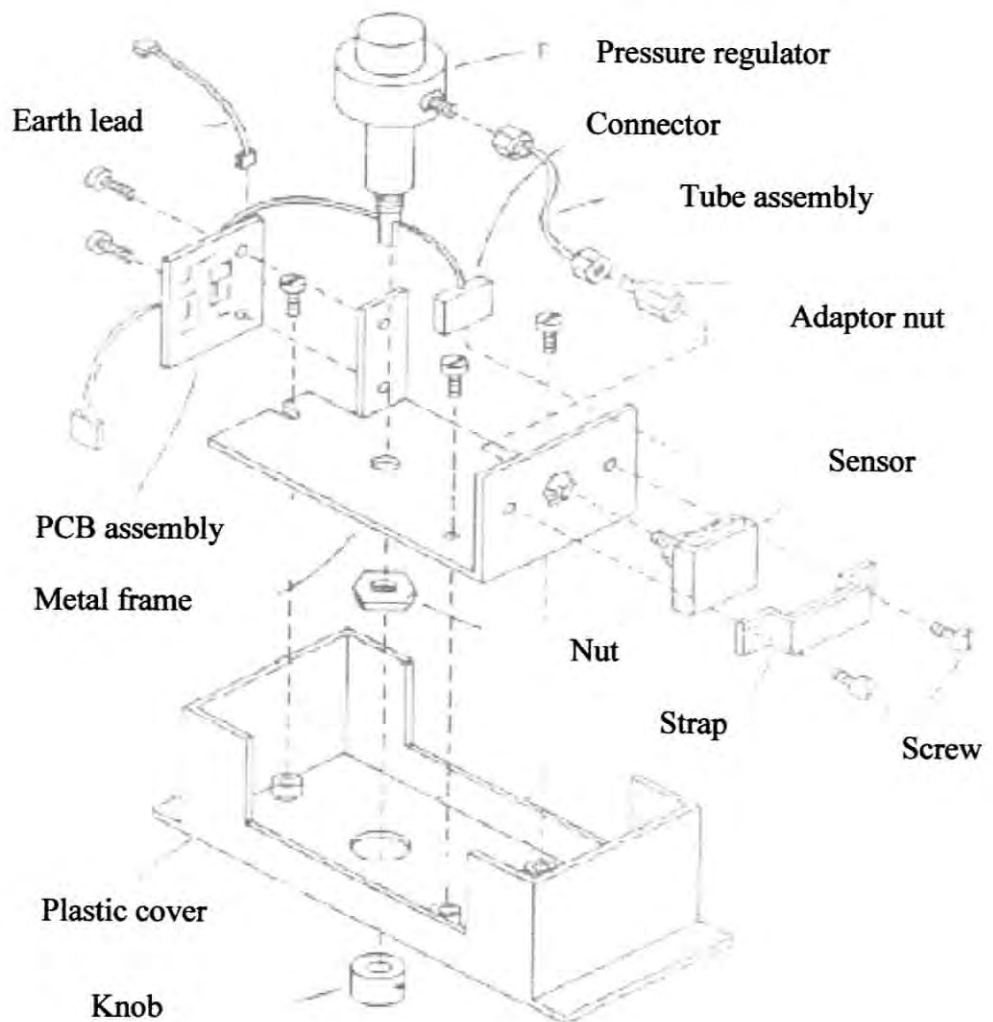


Figure 2.1: Before DFMA (David E. Lee and Thomas H. Hahn, 1996)

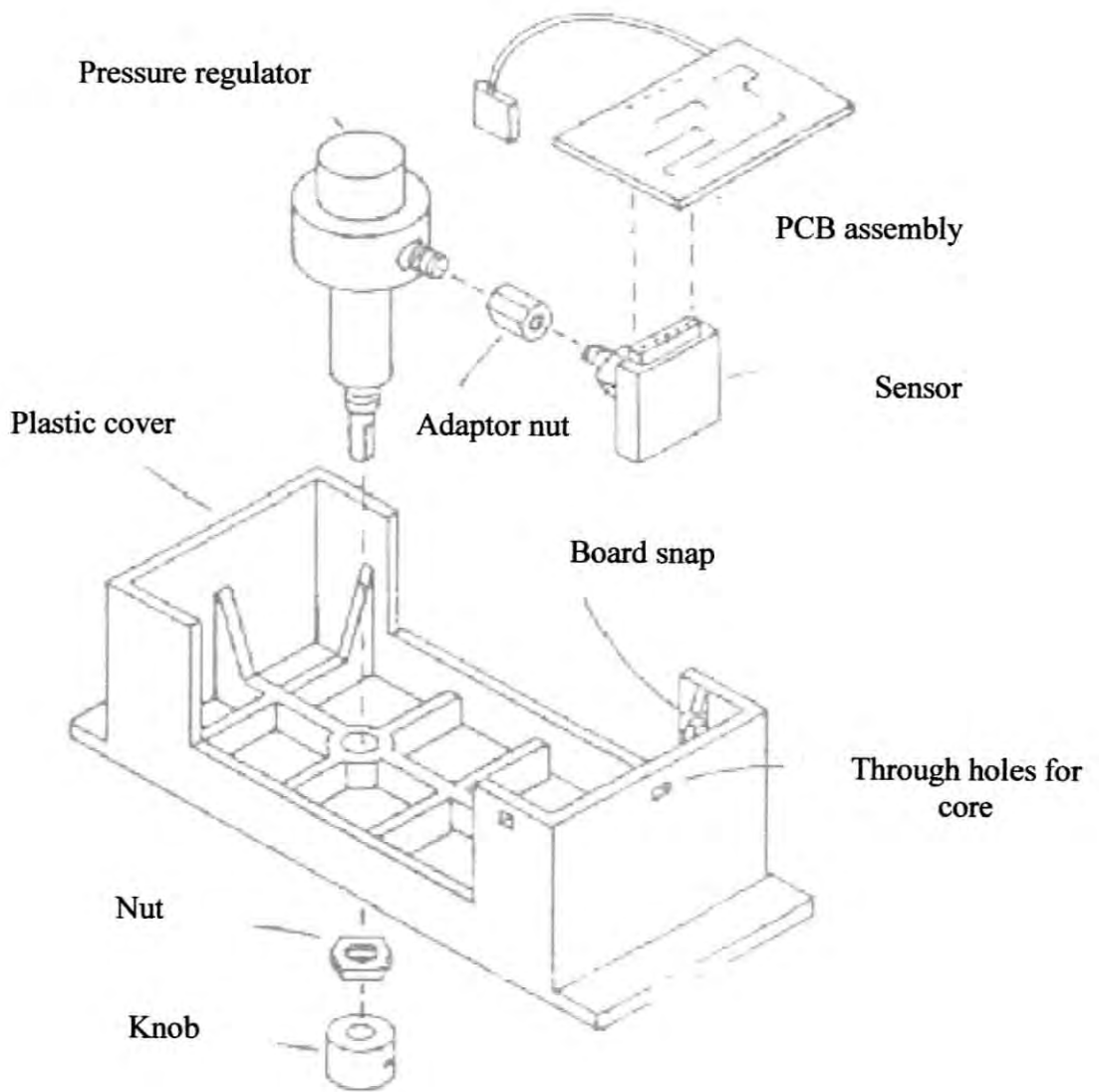


Figure 2.2: After DFMA (David E. Lee and Thomas H. Hahn, 1996)

The part was reduced into 7 parts. The sensor, hold was cut, simplify the regulator connector and cover plastic turn to give more contribute.