NATIONAL TECHNICAL UNIVERSITY COLLEGE OF MALAYSIA

APPLICATION OF DESIGN FOR ASSEMBLY METHODOLOGY ON AUTOMOTIVE PARTS

Thesis submitted in accordance with the requirements of the National Technical University College of Malaysia for the Degree of Bachelor of Engineering (Honours) Manufacturing (process)

By

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May 2006

KOLEJ UNIVERSITI TEKNIKAL KEBANGSAAN MALAYSIA

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APPROVAL

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ABSTRAK

Untuk menghasilkan suatu produk, ia perlulah melalui satu proses bagi menjadikannya produk pembuatan yang lengkap iaitu proses pemasangan. Pemasangan adalah tahap yang penting pada pembangunan produk dalam banyak industri seperti automotif, elektrik, aeroangkasa, dan sebagainya. Rekabentuk untuk pemasangan ialah satu daripada teknik untuk memperingkatkan rekabentuk produk supaya mudah dipasang dan kos pemasangan rendah dengan kefungsian produk yang tinggi dalam masa yang sama, boleh mengurangkan bilangan kandungan peralatan dalam satu pemasangan yang lengkap dan mengurangkan kos penghasilan produk. Dalam pembelajaran ini telah dibincangkan lebih mengenai aplikasi kaedah rekabentuk untuk pemasangan pada peralatan automotif , dan tumpuannya adalah pada sistem tingkap kuasa kereta . Objektif pembelajaran ini adalah bagaimana hendak mengurangkan bilangan kandungan peralatan pada suatu produk, menjadikan peralatan pemasangan supaya mudah dipasang, dan dalam masa yang sama boleh mempertingkatkan mutu rekabentuk produk , kualiti produk dan kebolehpercayaan produk. Skop pembelajaran ini merangkumi penggunaan satu perisian bagi membantu dalam menganalisis produk dan membuat keputusan berkenaan penggunaan rekabentuk untuk pemasangan (DFA) dalam proses pembaikan rekabentuk, keutamaan adalah pada peralatan kenderaan automotif iaitu sistem tingkap kuasa kereta (proton wira).

ABSTRACT

To produce a product, there mast through one process to make a complete manufacturing product is assembly process. Assembly is important stage at product development in most industry such as automotive, electronic, electrical, aerospace, and so on. Design for Assembly is one of the technique for improve the product design in order that easier to assemble and least assembly cost which high functionality product in same time, cane reduce total part count in complete assembled product and reduce the product manufacture cost. In this study will be discussed more about application design for assembly methodology on automotive parts, and the focused on car power window system. Objective of this study is how to reduce the part count of the product, make the part count easy to assembly, and same time improves the product design, quality and reliability. Scope of this study includes using software for helped to doing the analysis and makes decision about applying DFA in improvement design process, especially are on car power window system (proton wira).

DEDICATION

To my beloved mother and father & my siblings who have the confidence on me to overcome all the obstacles on any journey to success. I'm appreciated yours sacrifices.....

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TABLE OF CONTENTS

LIST OF FIGURE

LIST OF TABLE

SIGN AND SYMBOLS

DFA	Design for Assembly
DFM	Design for Manufacturing
DFMA	Design for manufacturing and Assembly
DITDFA	Design Improvement through Design for Assembly
FAST	Function Analysis System Technique
BDI	Boothroyd Dewhurst, Inc.
CAD	Computer Aided Design
SMEs	Small Manufacturing Enterprises
PLCs,	Programming Logic Control
PDM	Product Data Management
CSM	Component Supplier Management
VE	Value Engineering
AEM	Assembly Evaluation Method
FAST	Function Analysis System Technique
DC	Direct Current
V	Volt

CHAPTER 1

INTRODUCTION

1.1 Background

Application design for assembly begins after Second World War in manufacturing industry to produce military equipment and facilities such as weapons, tanks, and air-craft and so on. Assembly is important stages in producing complete assemble to be a finish product and ready for marketing. Application assembly was more using in automotive industrial for produced a complete engine assemble and car body assembly for to be a complete product is a car.

In the globalization era, people will talk about the quality, reliability and price of the product. As a designer we must be sensitive about our market, and always ready to do the improvement and development from the product for solving the technical problem in the design and manufacturing.

The factor for products success is dictated by its cost, performance and reliability. This is done by giving pressure to the market place and gives pressure companies to cut down the manufacturing cost and at the same time to increase their profit in order to remain competitive. This is to make its new product with competitive price, high quality, and reliability. So, companies have to try to maintain their market share by developing new products or introducing a product variety in a very short time with high quality, reliability and low cost. From the factor above, lots of company seeks

to apply a new design method as a counter measure to make sure their product can maintain at market place, but all product design have its own life cycle on the market stage. The phases of a product life cycle can be divided into the phases shown in the figure 1.1 below.

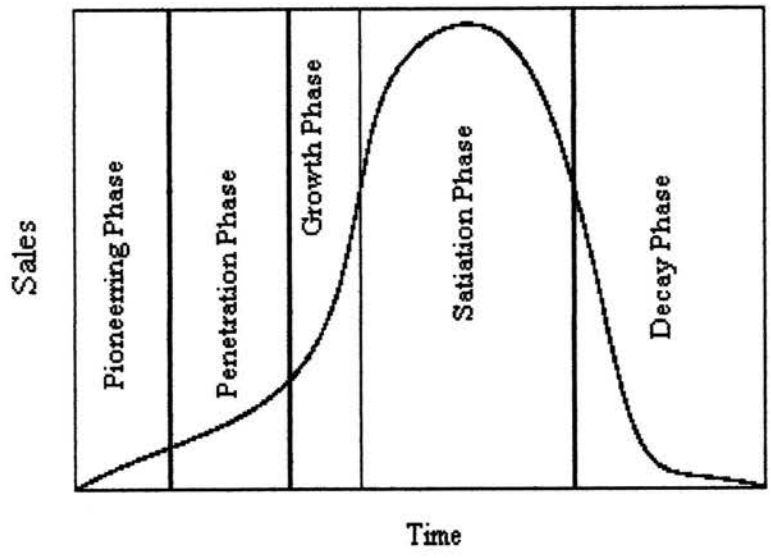

Figure 1.1: Product life cycle phases [Rempersad, 1993)

Description

1. Pioneering Phase – a launching period when the product is new at market, users don't know about that product, about the quality, reliability, function, and advantage of the product.
2. Penetration Phase – a promotional period when the product is promoted through out the market. In this phase, manufacturer start the marketing strategy for promoted the product to our user, through explanation about the product advantages.

3. Growth Phase – a period when the product starts to make and increase the profit. Users already know about the product like using that product.
4. Satiation Phase – a period where the product has lost its impetuous and growth slowly. Ware this period, product quality has more new competitor on the market which new technology and improvement. Product selling start to decries.
5. Decay Phase – a period of decline at the end of life

As the time changes, the customer needs are also changing. The changes of the customer needs will be due to the better product, quality and reliability factors. The product disappears from the market after certain period drastically.

1.2 Product Development

Product knowledge and design decision not expanding parallel together during in traditional development of product, because of that design decision and product knowledge not growing with similar and lastly that can give problem of design paradox. This refers to the mismatch of designer knowledge about the product and number of decision to be made throughout product development cycle as shown in figure 1.2. Design decision witch be made in early design process when product design is not very well understood. Because of that development process mast doing at traditional product for produced a product that have correct design decision appropriate with design evolves.

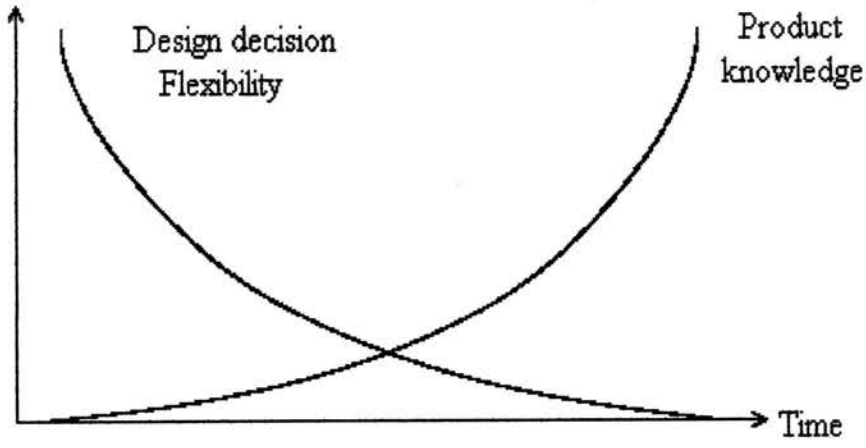

Figure 1.2: The design Paradox.

Separated between manufacturing engineer and manufacturing engineer is offered during Conventional development process stage. Because of that will cause at manufacturability in the product is not considered in design, effect of that is late to be corrected. Consequent will increase the product cost.

To perform from introduced a product with better quality, low cost and with shorter time for product producing. It is necessary for designer to produce any product development with short time. From shorter time for development this can improve product quality, and reduced the product cost for manufacture a certain product. Consideration on cycle phase of development can give parallelism in reducing product time and cost compared to traditional as shown in figure 1.3 below.

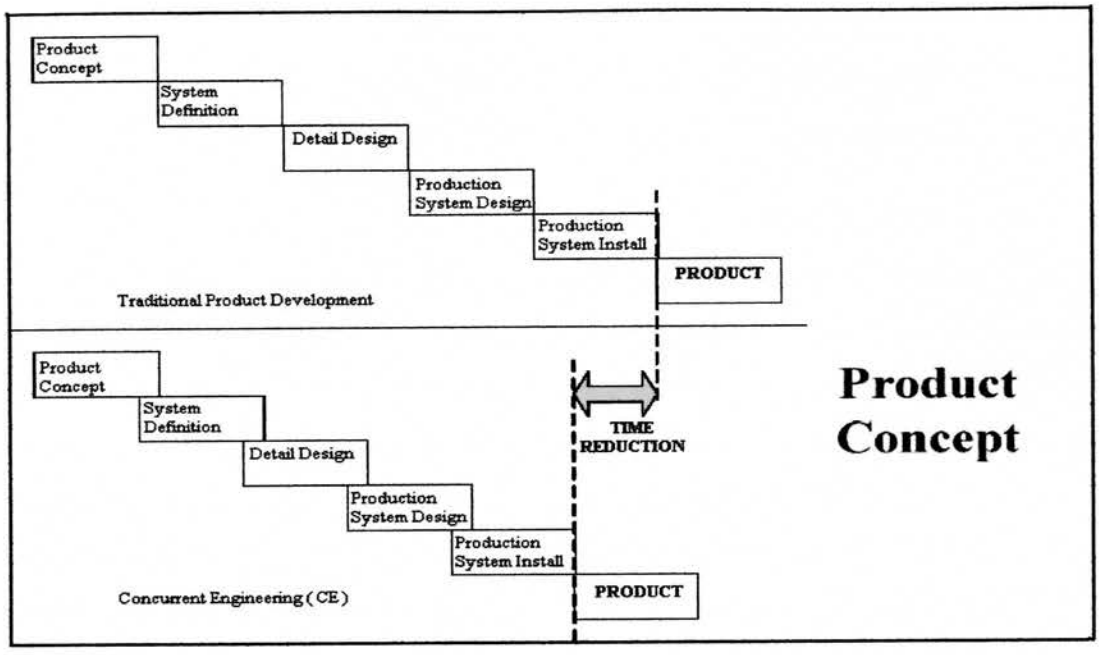

Figure1.3: Traditional Product Development vs. Concurrent Engineering. (Zakri bin Gazalli, 2003)

Three major benefits are achieved if working as a team in parallel:-

1. Early identification and possibility to avoid problem at later stage development.
2. Reducing development period compared traditional development.
3. Can offer new technology and improvement of the product in short time.

Concurrent engineering enables every design stage could be initiated simultaneously if differentiate with the traditional product development that only permits any design stage to be achieved one at a time. The concurrent engineering enables overlapping that contributes to the time reduction

As a manufacturer, mast to planning about ability machinery factor for produced the products in high production rate, this intend to as specification for each part in the products to fit and easy at certain machine or assembly process for produce the product

in meaning how to manufacture the product with easy and lower cost. These meaning the product not only fulfill certain functional specifications to attract customer to buy it, but must take account at machining process for produced that product under stage of manufacturing and assembly process.

There are techniques for focusing the assembly aspects in the design phases called "design For Manufacturing (DFM)', and "Design For Assembly". These techniques are well known methods that are used to avoid manufacturing and assembly problems in the process systematically. The basic idea is to eliminate the potential problems that are likely to occur in the manufacturing and assembly in early stage of the product development. To demonstrate the broad essence of this approach Value Engineering and Lucas DFA are discussed in this study. These methods provide a rational and systematic approach to achieve the product design development goals and concurrently allow the design improvements.

The developed method integrate the principles fro Value Engineering and Lucas DFA method. It starts with analysis of the product and from that it will analyze the product basic and secondary functions by adopting the Function Analysis System Technique (FAST) and from that the degree of involvement of the assembly operations will be analyzed in order to achieved the intended function. After if has been through the mentioned stage, the value and the optimization priority area of the products will be calculated. This method also attempted to introduce the step by step procedure for redesign method for the proposed methods. (Zakri bin Gazalli, 2003)

1.3 Cost reduction through improved design

During the development stages of a new product, cost and cost drivers certainly deserve careful consideration. Yet they tend to be neglected, especially when designers lack a reliable method of managing and understanding them. If the goal is to improve the products without increasing actual costs, the lack of cost detail during design can really hold back. Design teams often find themselves relying on historical manufacturing and assembly costs recorded for previous or similar versions of a product, for example, or on supplier best estimates. Usually, designers have no way of accurately quantifying whether the specific innovation they are contemplating will increase or reduce overall product cost. (Boothroyd Dewhurst www.dfma.com)

In this new era the DFMA have suite of software, you can use anytime during the product development cycle to analyze and understand the cost effects of your design decisions. Using DFMA software equips you with quick and accurate cost information. The software also provides a way to work creatively and objectively for improving design efficiency and profitability. Have three phases of improving product designs while reducing costs will present below.

1.3.1 Cost reduction through product simplification:

During the early stages of design, control of part count is paramount to maintaining cost targets. Designs for Assembly (DFA) can help you simplify products by focusing the attention of design teams on part count and part count reduction through the application