DESIGNING AND FABRICATION MODULAR PRODUCTS WITH THE INCORPORATION OF DIY ASSEMBLY METHOD (STUDY TABLE)

MOHD HAFIZZOL BIN KARIM

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

SUPERVISOR DECLARATION

'I hereby declare that the quality of the thesis written is sufficient for the award of Bachelor of Mechanical Engineering (Design & Innovation)'

Signature	: .....
Supervisor	: SITI NURHAIDA BTE KHALIL
Date	: JUNE 2012

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MOHD HAFIZZOL BIN KARIM

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DECLARATION

"I declare that this report entitle "Designing and Fabrication Modular Products with the Incorporation of DIY Assembly Method (Study Table)" is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree"

Signature : ……

Name : MOHD HAFIZZOL BIN KARIM

Date : JUNE 2012

To my beloved family. Thank for all your support.

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ABSTRACT

Table is a product that is widely used in human daily life including study table, where this study table is often used for placing the bookcase, stationery, personal computer, and learning activities. Objective of this project is to develop a study table that incorporate with the modular product design concept and DIY assembly method. A scientific research related to both these concepts has been carried out to obtain a clear picture of the development process of a study table. A good modular design study table has been constructed after the application of engineering design process in this project development. DFMA guideline has been implemented and as the result, a study table with DIY assembly method has been produced. A downscale 1:2 prototype has been fabricated to illustrate the shape and general attribute of the study table.

ABSTRAK

Meja merupakan produk yang digunakan secara meluas dalam kehidupan harian manusia, termasuk meja belajar, di mana meja belajar ini sering digunakan bagi meletakkan buku, alat tulis, komputer peribadi, dan aktiviti pembelajaran. Objektif projek ini adalah untuk membangunkan meja belajar yang menggabungkan konsep reka bentuk modular dan kaedah pemasangan kendiri (DIY). Penyelidikan saintifik yang berkaitan dengan kedua-dua konsep-konsep ini telah dijalankan untuk mendapatkan gambaran yang jelas tentang proses pembangunan sebuah meja belajar. Meja belajar yang mempunyai reka bentuk modular yang baik telah dibina selepas pengaplikasian proses reka bentuk kejuruteraan dalam pembangunan projek ini. Garis panduan DFMA telah dilaksanakan dan sebagai hasilnya, sebuah meja belajar dengan kaedah pemasangan DIY telah dihasilkan. Sebuah prototaip berskala 1:2 telah dibangunkan untuk menggambarkan bentuk dan sifat am meja belajar tersebut.

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LIST OF ABBREVIATIONS

CAD	Computer Aided Design
DIY	Do It Yourself
DFA	Designs for Assembly
DFM	Designs for Assembly
DFMA	Designs for Manufacturing and Assembly
PDS	Product Design Specification

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

The early history of table exist at the time of the ancient Egyptian society, where material for the construction of the table at the time was based on the rock and it is used to place objects on it. Evolutionary changes in the construction of a table can be seen in terms of design and functionality of a table, in line with developments in technology and living standard of mankind (Wikipedia, Table (furniture), n.d.).

At this present time, the table is one of the most important furniture in human life where it can function in various aspects, and in the context of this project, study table is functional as furniture or equipment to help people implement the learning process or work associated with it. In the modern era, the design of a study table came in many variations and concept. One well-known concept is ready-made study table, where the fabrication and installation was done by the manufacturer at the factory. This means that the user does not need to struggle to perform the installation process the table because it already installed by the manufacturer and configuration of the table cannot be changed randomly because it is a fixed configuration according to the manufacturer's original design plan. These sometimes cause discomfort to the user because they cannot change the basic configuration of the table due to the determination of the manufacturer's design plan and this fixed condition results the table has only one configuration instead of multi configurations according to user’s need (Kuznetsov, 2009).

This matter has caused a new trend emerging in the world of furniture, it is modular furniture and study table is no exception in this case where there are a lot of modular study table on the market. In the same time, another phenomenon has emerged in the furniture market, which also adopted alongside with these modular design products. We are no stranger to the DIY assembly methods for furniture. This assembly method is a system that is contrary to the ready-made system, where the purchaser or user must install the products at their homes based on their skill and manufacturer manuals. One company that successfully pioneered this field is IKEA, they have been developing and creating new innovations in modular furniture including study table (Rosner, 2009).

1.2 OBJECTIVE

The project purposed is to design and develop a study table that meets the desirable traits of DIY assembly method and modular design concept. In this project, methods and techniques used in the study of modular design concept, DIY assembly method and DFMA of a product development applied to obtain optimum final product that meets customer needs.

1.3 SCOPE

First scope of this project is applying the key concepts of modular design in the production of study table. Each of the concepts included in the project will be examined as possible so that the modular design concept can be applied properly.

Secondly, develop a study table that can meet the needs of DIY assembly method. This DIY assembly method must be easily understood and carried out by the user without the help of experts.

The third focus of this project is the implementation of the basic principles of DFMA in the process of developing the study table.

1.4 PROBLEM STATEMENT

Design of the furniture is important to ensure that it can be adapted easily to the layout of a space. One of the main problems that can be seen in the design of ready-made system is the configuration of developed study table cannot be changed with the various environment. Configuration of this type of study table is fixed based on the manufacturer's original design and users who use ready-made study table will be struggling to adjust their study table into their furniture layout (Kirk, 1990).

To overcome this problem, the modular design study table is proposed so that this study table can be adapted to the various aspects of the furniture layout. Through creativity and customer needs, they are able to adjust the study table in a various conditions based on various configuration of the study table (Snead, 1992).

In other aspect, DIY assembly method for furniture, including study table, became trending among consumer. This method most required basic skill of users to understand the configuration and design of that study table. But, some of this study table are manufactured with slightly high level of complexity and cause difficulty for the user to perform the DIY assembly process. To reduce the burden experienced of the users, design principal of study table should be easy, simple, lightweight, and at the same time must be stable so that it can be assemble easily by the users (Kuznetsov, 2009).

1.5 CONCLUSION REMARK

This chapter introduces the major objectives of this project. The background for this project was briefly described to get a clear view on what problems that arise regarding this project. Details on the scope of this project have been discussed so that all the work and processes are relevant and within the main objective of this project.

CHAPTER 2

LITERATURE RIVIEW

2.1 INTRODUCTION

Literature review is a step of understanding every data related to this project. The data are come from all kind of research including journals, magazines, internet, any reference books or other kind of sources including having a survey, interviews and even taking seminar which is relevant to the project. Literature review is essential to get specific knowledge and information before making any development of the project. We can consider literature review as guidance for the progression and to make sure the ongoing project is still on the area of study. This chapter will summarize on the details of the scope of project, any equipment used and technology involved in the design of study table.

2.2 CONCEPTUAL DESIGN

The engineering design process has been depicted as a stream of potential designs for a new product that will fit the needs of a targeted group of consumer. Product development begins by determining what the needs are that a product must meet and problem definition is the first of the whole product development process, where understanding any problem that occur is crucial to reaching the best solution (Glegg, 1969).

2.2.1 Problem Definition

Further step to be taken in early stage of product conceptual is gathering information related to the product literature itself. The information that related to do the engineering design is of many types and occurs in many forms other than the written word. Some examples are come from costumer surveys and feedback, specs and drawings for previous versions of the product, and so many more relevant sources. By placing the gathering information step between the problem definition and concept generation step, we are able to find the crucial information needed to perform a creative concept solution (Dieter, 2009).

2.2.1.1 House of Quality (HoQ)

The House of Quality (HoQ) develops the relationships between what customers want from a product and which of the product's features and overall performance parameters are most critical to fulfilling those want (Dieter, 2009). The HoQ matrix (Figure 1) is the most recognized and widely used form of this method. It translates customer requirements, based on marketing research and benchmarking data, into an appropriate number of engineering characteristics to be met by a new product design (Terninko, 1997).

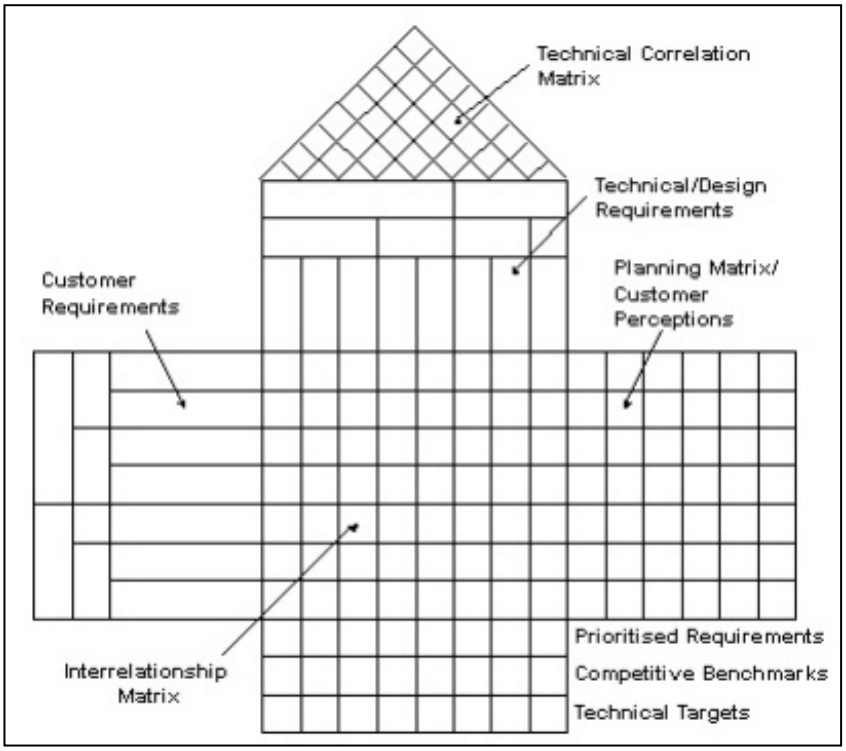

Figure 1: HoQ matrix translate costumer requirement into engineering characteristic (Source: Terninko, 1997)

2.2.1.2 Product Design Specification (PDS)

The product design specification (PDS) is a document listed the critical parameters, specifications and requirements for the product and it is a statement of what the product should be and should do (Dieter, 2009).

The PDS will constantly change throughout the project progresses as more information is gained. Detail is added as the design grows. The PDS is will be based on customer needs and the constraints imposed upon the system. The detail that will included in this project PDS are:

- Product identification
- Key project deadlines
- Physical description of the product

2.2.2 Concept Generation

Concept generation is a step in the product development when alternative design concepts are generated, evaluated, and selected. Terms design concept can be defined as an alternative that includes at least physical principles, abstract embodiments, geometric properties, and many more.

To get the best selection of design concept, brainstorming session must be included in the design process for generating creative ideas. The very first step in performing the best brainstorming session is defined the problem occur. Participants in brainstorming session must come out with their own free-flowing ideas and react to ideas of other participants by recalling their own thoughts about the same concepts (Dieter, 2009).

2.2.2.1 Functional Requirements

The engineering design specification is important to get the information on costumer and company requirements. But, sometime the information may lack sufficient details on specific function or sub function of the product. To overcome this problem, product component decomposition and product function decomposition is the way to clarify the product functional decomposition (Ullman, 1997).

Component decomposition diagram can be drawn by disassembled the product into their own respective components. It is a diagram of the parts and subassemblies that built up the product. The diagram (Figure 2) shows the hierarchical structure of component forms instead of functions. Subdivided the individual subassemblies into their own respective components, a better overall understanding of how individual component interact with each other is obtained (Eggert, 2005).