

**DESIGNING AND FABRICATION MODULAR PRODUCT WITH
THE INCORPORATION OF DIY ASSEMBLY METHOD
(SHOE RACK)**

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of the requirement for the
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DECLARATION

“I declare that this report entitle “Designing and Fabrication Modular Products with the Incorporation of DIY Assembly Method (Shoe Rack)” 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:

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Date: JULY 2012

Especially for my beloved mother

Nik Zakiah Binti Nik Idris

Also my beloved siblings

Nik Zarina Binti Nik Mahmood

Nik Zuhara Binti Nik Mahmood

Nik Zakimah Binti Nik Mahmood

Nik Zulfikri Bin Nik Mahmood

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ABSTRACT

Shoe rack is a product to put a shoe with an orderly and tidy manner; it is divided into two basic forms of open and closed like an existing market. These shoe racks have two type of shoe racks are ready assembled and not been installed. A shoe rack is provided that included a pair of side frames configured in a substantially rectangular shape. Each side frame includes a plurality of v-shaped support members containing two intersecting support. This thesis implemented with the aim to produce a design of a closed shoe rack using three methods of *'Do it yourself' (DIY)*, *'Modular design'* and *'Design for manufacturing and assembly' (DFMA)*. Of the three method used, the design of this shoe rack is designed to facilitate the user can install the shelves of shoes by themselves, without help from others and also without the help of a paid professional or grants (in general: an activity in which a person to do something themselves or on their own initiative), This DIY method also gives us the knowledge to install something with their creativity. The *'modular design'* is applied to produce different products by combining the normal component, while the method of *'Design for manufacturing and assembly'* is used for the design process focused on the needs of customers in the factors of cost, quality and performance.

ABSTRAK

Rak kasut adalah satu produk untuk meletakkan kasut dengan cara yang teratur dan rapi, ia terbahagi kepada dua bentuk asas terbuka dan tertutup seperti yang sudah ada dipasaran. rak kasut ini juga terdapat 2 jenis iaitu rak kasut yang sudah siap dipasang dan juga rak kasut yang belum dipasang. Tesis ini dilaksanakan dengan matlamat untuk menghasilkan satu rekabentuk rak kasut yang tertutup dengan menggunakan 3 kaedah iaitu '*Do it yourself*' (*DIY*), '*Modular design*' dan juga '*Design for manufacture and assembly*' (*DFMA*). Daripada ketiga-tiga kaedah yang digunakan ini, Rekabentuk rak kasut ini direka untuk memudahkan pengguna dapat memasang rak kasut dengan sendiri tanpa bantuan orang lain dan juga tanpa bantuan profesional yang dibayar atau bantuan (secara umumnya: suatu aktiviti di mana seseorang melakukan sesuatu yang diri sendiri atau atas inisiatif sendiri), Kaedah *DIY* ini juga memberikan kita pengetahuan memasang sesuatu dengan kreativiti mereka. Kaedah '*modular design*' pula diaplikasikan untuk menghasilkan produk yang berbeza dengan menggabungkan komponen biasa, manakala kaedah '*Design for manufacturing and assembly*' pula digunakan untuk reka bentuk proses yang memberi tumpuan kepada keperluan pelanggan dalam faktor-faktor kos, kualiti dan prestasi.

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	TITLE	i
	DECLARATION	ii
	DEDICATION	iii
	ACKNOWLEDGEMENT	ix
	ABSTRACT	v
	ABSTRAK	vi
	LIST OF TABLES	ix
	LIST OF FIGURES	
	LIST OF ABBREVIATION	
1	INTRODUCTION	
	1.1 Background	1
	1.2 Objective	3
	1.3 Scope	3
	1.4 Problem Statement	3

2	LITERATURE REVIEW	
	2.1 Introduction	5
2.2	Engineering Design Process	6
	2.2.1 Conceptual Design	7
	2.2.1.1 Concept Generation	7
	2.2.1.2 Concept Selection	8
	2.2.1.2.1 Pugh Concept Selection Method	8
	2.2.2 Embodiment Design	10
	2.2.2.1 Product Architectures	10
	2.2.2.1.1 Modular Product	11
	2.2.2.1.2 Modularity	13
	2.2.2.2 Configuration Design	13
	2.2.2.3 Parametric Design	14
	2.2.3 Detail Design	15
	2.3 Do it yourself (DIY) method	15
	2.4 Design for Manufacturing and Assembly (DFMA)	17
3	METHODOLOGY	
	3.1 Introduction	19
	3.2 Define Problem	21
	3.2.1 Benchmark	21
	3.2.2 The House of Quality (HoQ)	22
	3.2.3 Product Design Specification (PDS)	24
	3.2.4 Gathering information	26
	3.2.5 Component Decomposition	27
	3.3 Concept Generation	28
	3.4 Concept Selection	29
	3.5 Product Architecture	31
	3.6 Configuration Design	32
	3.6.1 Generating Alternative Configurations	32

	3.6.2	Analyzing Configuration Designs	32
	3.6.3	Evaluating Configuration Designs	33
	3.7	Parametric Design	33
	3.8	Detail Design	34
	3.9	Prototyping and Testing	35
	3.10	Conclusion Remark	35
4		RESULT AND DISCUSSION	36
	4.1	Introduction	36
	4.2	Define Problem	36
	4.2.1	Benchmarking	37
	4.1.1.1	Benchmark Product	
	4.1.1.2	Part Analysis on Benchmark Product	
	4.1.1.3	Engineering Characteristic of Benchmark Product	
	4.2.2	The House of Quality (HoQ)	41
	4.2.3	Product Design Specification (PDS)	43
	4.3	Concept Generation	45
	4.3.1	Concept Design 1	46
	4.1.2	Concept Design 2	47
	4.1.3	Concept Design 3	48
	4.4	Concept Design Selection	49
	4.1.4	Pugh Method	49
	4.5	Product Architecture	50
	4.6	Configuration Design	52
	4.6.1	Standard Part	53
	4.6.2	Selection of Materials	54
	4.7	Parametric Design	54
	4.7.1	Material Properties	54

	4.8	Detail Design	56
		4.8.1 DFA Analysis	61
	4.9	Prototype	68
	4.10	Conclusion Remark	69
5		CONCLUSION AND RECOMMENDATION	70
		REFERENCES	71
		APPENDIXES	

LIST OF TABLES

NO	TITLE	PAGE
2.1	Example Pugh Method Evaluation Chart	9
2.2	Definition from author	13
2.3	Comparison between DFM and DFA	17
3.1	Example of PDS for Shoe Rack	25
4.1	House of Quality on Shoe Rack	42
4.2	PDS of modular shoe rack with DIY assembly method	44
4.3	DFA for body of benchmark	64
4.4	DFA for drawer of benchmark	65
4.5	DFA for body of new design	66
4.6	DFA for drawer of new design	67

LIST OF FIGURES

NO	TITLE	PAGE
1.1	Example of closed Shoe Rack	1
2.1	Engineering Design Process	6
3.1	Flowchart of the project	20
3.2	Example of House of Quality	22
3.3	CES EDUPACK 2011 Software	26
3.4	Example of overview information from CES EduPack	27
3.5	Product Decomposition of existing design of Shoe Rack	27
3.6	The flow of process brainstorming	29
3.7	Example of Pugh Method selection method	30
3.8	Flow chart of product architecture methodology	31
3.9	Software CATIA V5	34
4.1	Benchmark of Shoe Rack	38
4.2	The shoe rack divided two divisions	39
4.3	The body part of shoe rack	39
4.4	The drawer part of shoe rack	40
4.5	The basic measurement of Benchmark	41
4.6	Product component decomposition of shoe rack	46
4.7	Concept Design 1	46
4.8	Concept Design 2	47
4.9	Concept Design 3	48
4.10	The new concept of shoe rack	50
4.11	Combination two type of shoe rack	50
4.12	Combination four type of shoe rack	51

4.13	The part body of shoe rack	52
4.15	The drawer part of shoe rack	53
4.16	The Philips screw type	53
4.17	Basic properties of MDF	55
4.18	Final concept design for shoe rack (close)	56
4.19	Final concept design for shoe rack (open)	56
4.20	Exploded view for shoe rack	57
4.21	Part 1 (Upper and Lower part)	57
4.22	Part 2 (left and right part)	58
4.23	Part 3 (Lanes board)	58
4.24	Part 5 (Back Cover part)	58
4.25	Part 3 (Drawer)	59
4.26	Part 4 (plywood part)	59
4.27	Part 6 (Connecter part)	59
4.28	Comparison with Benchmark and new concept	60
4.29	Alpha and beta rotational symmetries	61
4.30	Handling Time Table	62
4.31	Insertion time	63
4.32	Prototype product	68
4.33	The drawer part	68
4.34	View inside the body part	69

LIST OF ABBREVIATION

DFMA	=	Design for Manufacturing and Assembly
DIY	=	Do It Yourself
PDS	=	Product Design Specification
HOQ	=	House of Quality
CATIA	=	Computer Aided Three-Dimensional Interactive Application
V5	=	Version 5
V6	=	Version 6
R20	=	Release 20
DFM	=	Design for manufacturing
DFA	=	Design for assembly
QFD	=	Quality Function Deployment
CAD	=	Computer Aided Design
CAM	=	Computer Aided Manufacturing
CAE	=	Computer Aided Engineering
MDF	=	Medium Density Fiberboard

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND



Figure 1.1: Example of closed 'Shoe Rack'

Nowadays, Shoe racks are created with a variety of forms for use in compiling the shoes neatly arranging shoes, boots, slippers or the like description. Usually shoe rack is designed in two conditions, open and closed. This present invention refers to a design type of shoe rack, especially useful in environments with limited availability of space for an additional piece of furniture serving as shoe-holder and boot-holder. History of

technology the invention of this new design of shoe rack is born to be placed on the doors of various household environments, or even hung on small wall spaces. The household problem of putting away shoes is currently solved by various types of furniture, always requiring a certain space, or with designs to be hung to doors, where the main elements for putting away footwear.

This shoe rack basic designed form of a box, but every year the design is constantly changing with more updates design at cheaper price using various materials and can be more easily used, it also does not focus on one form but has variety of aesthetic design and easy assembly. Shoe racks are used to look neat and tidy in every home, office or any place in order to be placed outside and in a place according to their requirements. Hence, all these problems can be solved by putting the shoes carefully at the right place, as well as the problem of dust on shoes and the smell can be addressed using a closed shoe racks.

This project shoe rack is more focused in small design closed shoe rack and easily lifted. It also can solve some existing problems such as ease to assemble by yourself. The concept of a closed shoe rack was chosen because the market is many readily available than the open shoe rack using DIY method. By creating a survey on this problem, this shoe rack will be designed based on several concepts to provide wider benefits in the manufacture of this closed shoe rack. In general, this shoe rack will be more focused on reducing manufacturing costs, easier installation, sturdy, easy assemble, durable, strong and more attractive

1.2 OBJECTIVE

This project is aimed to study the activities involved in design process for modular product concept for ‘Shoe Rack’ and fabrication of a prototype of the scale 1:2 using sustainable material. The modular product also has to incorporate DIY assembly method. DFMA of a product development and modular design concept also using in this project.

1.3 SCOPE

The scope of studies for this project is to focus on the implementation of modular design concept on close ‘Shoe Rack’ then DFMA method will be apply to the design for developing process. The final product then will be integrated with ‘DIY’ method. After using these three methods, the detailed design concept selected will be developed using software CATIA V5R20.

1.4 PROBLEM STATEMENT

Basically, there are a lot of aspects need to be considered when designing the closed ‘Shoe Rack’. Design of the furniture is essential to ensure that it can easily be adapted for space layout. One major problem that can be seen in the ready-made design configuration of advanced shoe rack can’t be changed with the environment.

Furthermore, the existing closed shoe rack product does not use the concept of DIY, usually this product is preinstalled and caused difficulties to move or slipper the product for point to another point. The product introduces simple functional design and easy installation method by incorporation DIY method. The product is aimed be packed in a flat packed boxes that could fit in box boots of any for ease of transportation.

Therefore, to overcome this problem, the modular design shoe rack is proposed so that this shoe rack can be adapted to the various aspects of the furniture layout. Through creativity and customer needs, they are able to combine the shoe rack in a various conditions based on various configuration of the shoe rack. (Snedd, 1992)

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter will discuss more about this project using the three concepts. The first topic to be discussed is modular products in embodiment design section. These topics also include definition and the advantages of using these concepts. The second concept will discuss the concept of *"Do it yourself" (DIY)* and also the concept of *'Design for manufacturing and assembly' (DFMA)* for this product design.

Three concepts that will be used in this project is *'modular design'*, *'Do it yourself' (DIY)* and *'Design for manufacturing and assembly (DFMA)*. There are many advantages through the concept of applied. One of the advantage is modular products to used for reduced and easier to installed on its own, usually existing indoor shoe racks do not use the concept of 'DIY', but is ready assembled, just open shelves just a lot of use the concept of 'DIY'. When a customer installs the product itself, the term 'DIY' will be used. 'DIY' is an act to build or modify without the assistance of any expert and otherwise do so freely. Usually products with DIY installation methods will be provided instructions for customers to facilitate the installation and use of basic tools.

2.2 ENGINEERING DESIGN PROCESS

Engineering design process has been described as a potential design flow of new products that will suitable the needs of the target user. Product development starts with determining what the requirements that a product must meet the definition of the first and the whole product development process, where the understanding of any problems that occur is essential to achieve the best solution [2].

The engineering design process can be used to achieve several different outcomes. However, the emphasis in this project is on product design because it is an area in which many engineers will apply their design skill. The design process is a sequence of events and set of guidelines that helps define a clear starting point that takes the designer a product. There are two sections in design process which is the conceptual design and embodiment design [2].

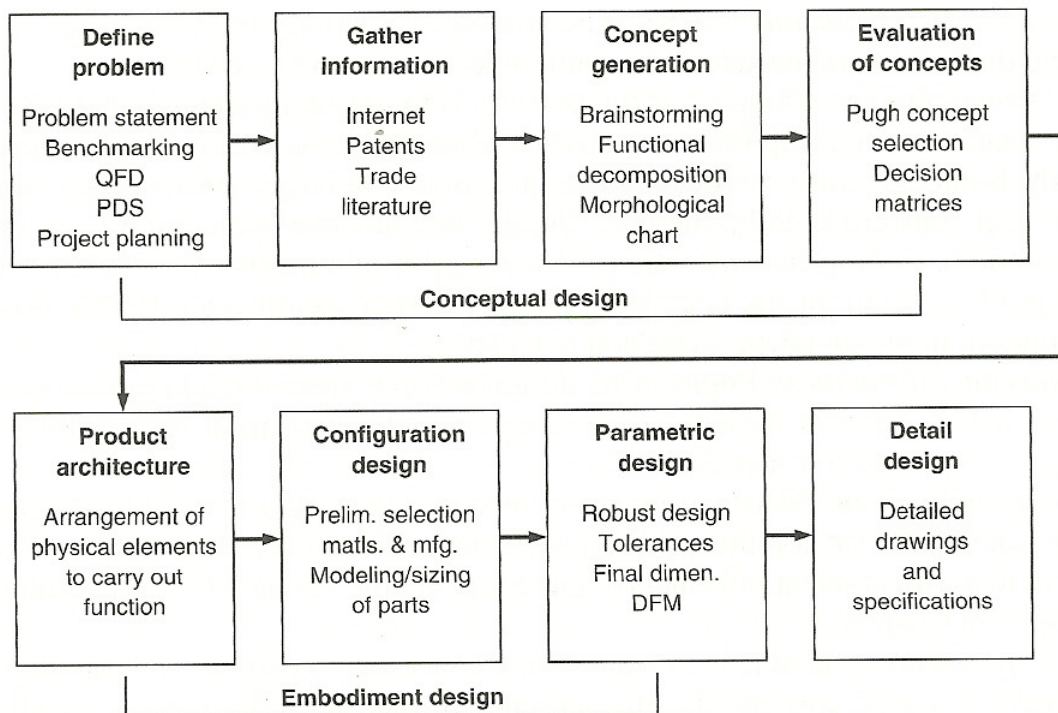


Figure 2.1: Engineering Design Process [2]

2.2.1 Conceptual Design

Conceptual design is the process by which the design is initiated, carried to the point of creating a number of possible solutions, and narrowed down to a single best concept. Conceptual design is the phase that requires the greatest creativity, involves the most uncertainty, and requires coordination among many function in the business organization. The following are the discrete activities that consider under conceptual design [1].

Furthermore, to be taken in the early stages of product concept to gather information related to the literature is the product itself. Relevant information to perform engineering design is a kind of a lot and come in several forms other than written words. Some examples are coming from the customer surveys and feedback, specifications and drawings for the previous version of the product, and so many resources that are more relevant. By placing the information gathering steps of problem definition and concept generation step, we can find the information required to implement the concept of creative solutions.

2.2.1.1 Concept Generation

This concept generation method is a step in the development of the product as an alternative design concept generated, evaluated, and selected. Terms of design concepts can be defined as an alternative that includes a minimum of principles, the embodiment of abstract and geometric [2].

To get the best design concepts, the study should be done in the design process to generate ideas that are more creative. The first step in implementing the best ideas are reviewed statement of the problem occurs. An idea that is obtained will be a concept but the idea is not similar to one another.

2.2.1.2 Concept Selection

After several concepts have been identified, the best concept will be used in this product. Among the methods used in this project to choose the specification is the Pugh method. This method can choose the product concept based on the criteria and specifications required in a new product [2]. This method is most effective if all the engineering design ideas implemented and agreed compared with only one method.

2.2.1.2.1 Pugh Concept Selection Method

The Pugh method can be performed by the following process:

1. Choose the comparison criteria
2. Select the alternative to be compared
3. Generate score

The Pugh selection chart shows that two of the proposed designs rank higher than the DATUM design. After taking the consideration, the engineering team chooses a concept to make it as a datum or benchmark. The concept will be given a positive (+) score if it is better than the datum and vice versa. The concept will be given zero (0) score if the concept equally with the datum [2]. After all the criterion of the concept and datum are compared, the three score will be generated based on the previous comparison score. That three score are the number of positive score, the number of negative score, the overall total, and the weighted score. The example Pugh method evaluation chart is shows on Table 2.1.

ROW	CRITERIA	CONCEPT			
		A	B	C	D
1	CRITERIA A	+	+	+	DATUM
2	CRITERIA B	=	-	+	
3	CRITERIA C	-	+	-	
4	CRITERIA D	=	=	=	
5	CRITERIA E	+	=	-	
6	CRITERIA F	-	+	+	
7	CRITERIA G	=	=	=	
8	CRITERIA H	+	+	=	
9	CRITERIA I	-	+	-	
10	CRITERIA J	=	=	+	
PLUSES		3	5	4	0
MINUSES		3	1	3	0

Table 2.1: Example Pugh Method Evaluation Chart [2]