



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**DESIGN IMPROVEMENT ON AN MPOC USING DFMA**

This report submitted in accordance with requirement of the Universiti Teknikal  
Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing  
Engineering (Manufacturing Design) with Honours.

by

**MUHAMMAD KHAIRUL AIZAT BIN MOHD RADZI**

FACULTY OF MANUFACTURING ENGINEERING

2009



# UNIVERSITI TEKNIKAL MALAYSIA MELAKA

## BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

**TAJUK: Design Improvement on an MPOC Using DFMA**

**SESI PENGAJIAN : 2008/2009 Semester 2**

Saya **MUHAMMAD KHAIRUL AIZAT BIN MOHD RADZI**

mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan Laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. \*\*Sila tandakan (√)

SULIT

(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia yang termaktub di dalam AKTA RAHSIA RASMI 1972)

TERHAD

(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)

TIDAK TERHAD

Disahkan oleh:

(TANDATANGAN PENULIS)

(TANDATANGAN PENYELIA)

Alamat Tetap:

J 4.6 JALAN AU 1B/1,

TAMAN KERAMAT PERMAI,

54200 KUALA LUMPUR.

Cop Rasmi:

**HASSAN BIN ATTAN**  
Jurutera Pengajar Kanan  
Fakulti Kejuruteraan Pembuatan  
Universiti Teknikal Malaysia Melaka

Tarikh: 13/05/09

Tarikh: 13/5/09

\*\* Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh tesis ini perlu dikelaskan sebagai SULIT atau TERHAD.



## UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Karung Berkunci 1200, Ayer Keroh, 75450 Melaka

Tel: 06-233 2421, Faks : 06 233 2414

Email: fkp@kutkm.edu.my

### FAKULTI KEJURUTERAAN PEMBUATAN

Rujukan Kami (Our Ref) :

Rujukan Tuan (Your Ref):

Pustakawan  
Perpustakaan UTeM  
Universiti Teknikal Malaysia Melaka  
Hang Tuah Jaya,  
75450, Melaka.

13 Mei 2009

Saudara,

**PENKELASAN LAPORAN PSM SEBAGAI SULIT/TERHAD LAPORAN PROJEK SARJANA MUDA KEJURUTERAAN PEMBUATAN (MANUFACTURING DESIGN): MUHAMMAD KHAIRUL AIZAT BIN MOHD RADZI**

Sukacita dimaklumkan bahawa Laporan PSM yang tersebut di atas bertajuk "Design Improvement on an MPOC using DFMA" mohon dikelaskan sebagai **SULIT/ TERHAD** untuk tempoh LIMA tahun dari tarikh surat ini.

2. Hal ini adalah kerana IANYA MERUPAKAN PROJEK YANG DITAJA OLEH SYARIKAT LUAR DAN HASIL KAJIANNYA ADALAH SULIT.

Sekian dimaklumkan. Terima kasih.

Yang benar,


.....  
HASSAN ATTAN

*Jurutera Pengajar,  
Fakulti Kejuruteraan Pembuatan*

**HASSAN BIN ATTAN**  
*Jurutera Pengajar Kanan*  
Fakulti Kejuruteraan Pembuatan  
Universiti Teknikal Malaysia Melaka

## DECLARATION

I hereby, declared this report entitled “Design Improvement on an MPOC” is the results of my own research except as cited in reference.

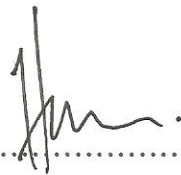
Signature : .....  .....

Author's Name : Muhammad Khairul Aizat Bin Mohd Radzi.

Date : 13 May 2009

## APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Design) with Honours. The member of the supervisory committee is as follow:



.....  
**HASSAN BIN ATTAN**  
*Jurutera Pengajar Kanan*  
Fakulti Kejuruteraan Pembuatan  
Universiti Teknikal Malaysia Melaka

## **ABSTRACT**

The project is based on an industrial product which will be used to apply Design for Manufacture and Assembly (DFMA) for improvement. There are some significant problems faced by the company such as resources in analysis and development of the existing design products and assembly process. The objectives of this project are mainly to propose an improvement on the design of the Multi Purpose Outdoor Cabinet (MPOC) by optimizing the usage of manufacturing processes and minimize the number of components in an assembly or on the parts. A discussion is also included on the differences between traditional manufacturing development and DFMA approach which is more helpful in the product design development. The background and explanation of the basic concept and method of Boothroyd Dewhurst DFA, Lucas DFA method and the Hitachi Assembly Evaluation Method (AEM) were compared and discussed in this report. Lucas DFA methodology is chosen in this research and will be use to look up for an efficiency in assembly flow of the product. The analysis was done using DFA TeamSET to improve efficiency and effectiveness of assembly process. In addition, the Time Study method has been used in order to identify the total estimated reduction of cycle time for the product in Assembly Department. Based on the improvement design report, graph chart is plotted and shows the reduction in percentage.



## ABSTRAK

Kajian ini berdasarkan produk industri dimana aplikasi ‘Design for Manufacture and Assembly (DFMA)’ digunakan untuk tujuan penambahbaikan. Objektif atau tujuan utama kajian ini adalah untuk mencadangkan pembaikan rekebentuk pada bahagian komponen produk yang sedia ada bagi mengoptimumkan penggunaan sistem dalam industri pembuatan dan juga mengurangkan bilangan komponen produk dalam pemasangan. Terdapat beberapa masalah yang dihadapi oleh syarikat seperti sumber dalam menganalisis serta penambahbaikan rekabentuk produk dan proses pemasangan yang sedia ada. Perbincangan juga menyentuh perbezaan penambahbaikan antara pembuatan tradisional dan kaedah ‘DFMA’ dimana ‘DFMA’ sangat membantu dalam penambahbaikan rekabentuk produk. Latarbelakang dan penerangan mengenai konsep asas dan kaedah dalam ‘Boothroyd Dewhurst DFA’, ‘Lucas DFA’ dan ‘Hitachi Assembly evaluation Method (AEM)’ dibincangkan dalam laporan ini. Panduan perbandingan telah dilakukan dengan menggunakan kaedah ‘Boothroyd Dewhurst DFA’ dan ‘Lucas DFA’. Kaedah ‘Lucas DFA’ telah dipilih untuk analisis kajian ini dalam konteks meningkatkan keberkesanan dalam pemasangan produk. Analisis menggunakan DFA TeamSET telah diaplikasikan bagi meningkatkan kecekapan dan keberkesanan di dalam proses pemasangan. Tambahan lagi, kaedah ‘Time Study’ telah digunakan bagi menentukan kitaran masa dalam pemasangan produk di bahagian pemasangan. Berdasarkan pada laporan pembaikan rekabentuk produk, graf carta telah diplot dan menunjukkan pengurangan dalam peratusan.

## **DEDICATION**

To God for His blessings,

To my beloved parents for their support,

To my family for standing beside me always,

To my supervisor Mr. Hassan Attan for his guidance,

To all my friends for their encouragement and help,

To Taiace Engineering Sdn. Bhd for helping,

And to everyone who had helped.



## **ACKNOWLEDGEMENT**

Alhamdulillah and Thank to Allah S.W.T. with all His Gracious and His Merciful forgiving me strength and ability to accomplish this project research successfully. I would like to offer thanks and deepest gratitude from the bottom of my heart for all the support, encouragement and inspirations I obtained throughout the duration of this project.

The first person I would like to take the utmost opportunity to express my sincere and gratitude to my supervisor, Mr. Hassan Bin Attan who is always giving me supports and guidance throughout the year in completing this Final Year Project I & II until up to this stage in victory. Besides that, his constant urge for me to complete my project helps me to complete this project in time. I also would like to convey my biggest appreciation to all the staff in Taiace Engineering Sdn. Bhd (TESB) especially Mr. Jailani and Mr. Ibrahim Mat Noor as Designer and QC Inspector for supporting and guiding in accomplishes my Final Year Project without hesitation. All knowledge and experience I gained would not be forgotten.

Finally, to all my fellow friends who involves direct or indirectly that always stand strong beside me in giving opinions, supports also criticism throughout our relationship, I really thankful and appreciate it. All yours are the most valuable things for the rest of my life. And last but not least, I would like to express my deepest gratitude to all those whom has lend me a helping hand to complete this project. With their help, I dare say that this project is a success.

# TABLE OF CONTENTS

Abstract	i
Abstrak	ii
Dedication	iii
Acknowledgement	iv
Table of Contents	v
List of Figures	ix
List of Tables	xiii
List of Abbreviations	xv
<b>1. INTRODUCTION</b>	<b>1</b>
1.1 Introduction	1
1.2 Project Background	3
1.3 Problems Statement	6
1.4 Objectives	6
1.5 Scopes	7
<b>2. LITERATURE REVIEW</b>	<b>8</b>
2.1 Introduction to Design for Manufacture and Assembly (DFMA)	9
2.2 Design for Manufacture and Assembly (DFMA) Process	11
2.3 DFMA versus Traditional Design Development	12
2.4 History and Background of Design for Assembly (DFMA)	15
2.5 Approaches to Design for Manufacture (DFM)	17
2.6 Approaches to Design for Assembly (DFA)	21
2.6.1 Basic DFA Guidelines	23
2.6.2 Benefits of using Design for Assembly (DFA) Software	24
2.7 Benefits of using DFMA Software	27
2.8 Various DFA Methodology	28

2.8.1	Boothroyd Dewhurst DFA	28
2.8.1.1	Boothroyd Dewhurst DFA Basic Method	29
2.8.1.2	Rotation Symmetries for various parts	31
2.8.2	The Lucas DFA	34
2.8.2.1	Lucas DFA basic method	35
2.8.3	The Hitachi Assembly Evaluation Method (AEM)	39
<b>3.</b>	<b>METHODOLOGY</b>	<b>44</b>
3.1	Project Overview	44
3.2	Analysis using Boothroyd Dewhurst DFA and Lucas DFA Methodology	48
3.2.1	Boothroyd Dewhurst DFA Manual Analysis	49
3.2.1.1	Calculation (Boothroyd Dewhurst DFA)	51
3.2.2	Lucas DFA Manual Analysis	52
3.2.2.1	Calculations (Lucas DFA)	53
<b>4.</b>	<b>ANALYSIS AND RESULT</b>	<b>56</b>
4.1	Introduction	56
4.2	Bill of Material (BOM) for Normal Parts MPOC	57
4.3	Bill of Material (BOM) for Purchased Parts MPOC	58
4.4	Picture for Normal Parts MPOC	59
4.5	Picture for Purchased (Standard) Parts MPOC	63
4.6	Tree Structure Diagram for MPOC	65
4.6.1	Tree Structure Diagram for Base Panel	66
4.6.2	Tree Structure Diagram for MDF Compartment	67
4.6.3	Tree Structure Diagram for Battery Compartment	68
4.6.4	Tree Structure Diagram for Rectifier Compartment	69
4.6.5	Tree Structure Diagram for Top Part	70
4.7	Assembly Working Procedure	71
4.8	Cycle Time for Base Panel	84
4.9	Cycle Time for MDF Compartment	87

4.10	Cycle Time for Battery Compartment	90
4.11	Cycle Time for Rectifier Compartment	93
4.12	Cycle Time for Top Part	96
4.13	Introduction Design for Assembly (DFA) tools	99
4.13.1	Basic DFA TeamSET Software	99
4.13.2	Performing a Functional Analysis (FA)	101
4.13.3	Performing a Handling Analysis (Hand)	103
4.13.4	Analyzing the Flowchart	104
4.13.5	Accessing the DFA Analysis Summary	106
4.14	Analysis and Result Using TeamSET	108
4.14.1	DFA TeamSET Analysis Result for Current and Improvement Base Panel	108
4.14.2	DFA TeamSET Analysis Result for Current and Improvement MDF Compartment	112
4.14.3	DFA TeamSET Analysis Result for Current and Improvement Battery Compartment	116
4.14.4	DFA TeamSET Analysis Result for Current and Improvement Rectifier Compartment	120
4.14.5	DFA TeamSET Analysis Result for Current and Improvement Top Part	124
<b>5.</b>	<b>DISCUSSION</b>	<b>128</b>
5.1	Introduction	128
5.2	Cycle Time in Assembly Process of MPOC	129
5.3	DFA Analysis Result for MPOC	131
5.4	Comparison and Total Reduction of Current and Improvement MPOC	133
5.5	Design Assembly Changes and Associated Reduction	136
5.5.1	Part Design Improvement	138
5.5.1.1	Part Design Improvement for Base Panel	138

5.5.1.2 Part Design Improvement for MDF Compartment	139
5.5.1.3 Part Design Improvement for Battery Compartment	140
5.5.1.4 Part Design Improvement for Rectifier Compartment	142
5.5.1.5 Part Design Improvement for Top Part	142
5.6 Design Guidelines and Considerations	144
5.7 Problem Identification Using Cause-And Effect Diagram	146
<b>6. CONCLUSION</b>	<b>149</b>
6.1 Conclusion	149
6.2 Future Recommendation	150
<b>REFERENCES</b>	<b>151</b>

## **APPENDICES**

A Gantt Chart for PSM I	
B Gantt Chart for PSM II	
C Manual Handling Analysis Table (BD DFA)	
D Manual Insertion Analysis Table (BD DFA)	
E Manual Functional Analysis Table (Lucas DFA)	
F Manual Handling Analysis Table (Lucas DFA)	
G Manual Fitting Analysis Table (Lucas DFA)	
H Partial of Technical Drawing for MPOC	

## LIST OF FIGURES

1.1	Multi Purpose Outdoor Cabinet (MPOC)	2
1.2	Process Flow Chart for Project	5
2.1	Survey on importance of reductions produced by DFMA	11
2.2	Typical stages in a DFMA procedure	12
2.3	Traditional Manufacturing Process	13
2.4	“Over the Wall” design, historically.	14
2.5	DFMA Software Average Reductions	17
2.6	Example of Design for Manufacture (DFM) Software	18
2.7	Cost reduction related to simple conceptual design parameters.	19
2.8	Overview of Design for Manufacture (DFM) process	20
2.9	Example of Design for Assembly (DFA) software	26
2.10	Stages of the Boothroyd Dewhurst DFA method	29
2.11	Lucas DFA method stage	34
2.12	Assemblability evaluation and design improvement flow diagram for Hitachi evaluation method	40
3.1	Process Flow of the project	47
3.2	Multi ink mechanical pen	48
3.3	Exploded view	48
3.4	Bill of Material (BOM) of Multi Ink Mechanical Pen	49

3.5	Boothroyd Dewhurst DFA manual Analysis	50
3.6	Lucas DFA manual analysis	52
3.7	Description of Boothroyd Dewhurst DFA and Lucas DFA methodology	54
4.0	Tree Structure Diagram for MPOC	65
4.1	The Tree Structure Diagram of Base Panel	66
4.2	The Tree Structure Diagram of MDF Compartment	67
4.3	The Tree Structure Diagram of Battery Compartment	68
4.4	The Tree Structure Diagram of Rectifier Compartment	69
4.5	The Tree Structure of Top Part	70
4.6	The Assembly Working Procedure 1	71
4.7	The Assembly Working Procedure 2	72
4.8	Assembly Working Procedure 3	73
4.9	Assembly Working Procedure 4	74
4.10	Assembly Working Procedure 5	75
4.11	Assembly Working Procedure 6	76
4.12	Assembly Working Procedure 7	77
4.13	Assembly Working Procedure 8	78
4.14	Assembly Working Procedure 9	79
4.15	Assembly Working Procedure 10	80
4.16	Assembly Working Procedure 11	81



4.17	Assembly Working Procedure 12	82
4.18	Graph of Comparison Current and Estimated Improvement Cycle Time for Base Panel	84
4.19	Graph of Comparison Current and estimated Improvement Cycle Time for MDF Compartment	86
4.20	Graph of Comparison Current and Estimated Improvement Cycle Time for Battery Compartment	89
4.21	Graph of Comparison Current and Estimated Improvement Cycle Time for Rectifier Compartment	92
4.22	Graph of Comparison Current and Estimated Improvement Cycle Time for Top Part	95
4.23	The Design for Assembly (DFA) TeamSET Analysis Window	98
4.24	Functional Analysis Window	100
4.25	Manual Handling Analysis Window	101
4.26	Symbol and Terminology in Assembly Flowchart	103
4.27	Insertion Process Window	104
4.28	DFA Analysis Summary Window	105
4.29	Chart of Comparison Current and Improvement DFA result for Base Panel	108
4.30	Chart of Comparison Current and Improvement DFA result for MDF Compartment	111
4.31	Chart of Comparison Current and Improvement DFA result for Battery Compartment	116
4.32	Chart of Comparison Current and Improvement DFA result for Rectifier Compartment	119
4.33	Chart of Comparison Current and Improvement DFA result for Top Part	124

5.1	Graph of Comparison Cycle Time between Current and Estimated Improvement of each Compartment	128
5.2	Graph of Percentage DFA reports for Current and Improment MPOC	131
5.3	Overall Percentage of Reduction in MPOC	132
5.4	Design changes for Base Plate Battery (02P)	135
5.5	Design changes for Base Hole Plate (03P)	135
5.6	Design changes for MDF Cover Plate (04P)	135
5.7	Design changes for Krone Bracket (08P)	136
5.8	Design changes for Back Hole Plate (09P)	136
5.9	Design changes for Battery Bracket (12P)	137
5.10	Design changes for Battery Fan Plate (13P)	138
5.11	Design changes for assembly Battery Fan Plate (13P)	138
5.12	Design changes for Plate Side Rectifier (16P)	139
5.13	Design changes for Roof Fan Bracket (20P)	139
5.14	Design changes for assembly Roof Fan Bracket (20P)	140
5.15	Cause-and-effect diagram for Assembly Process	143

## LISTS OF TABLES

2.1	Example of Manual Handling Analysis	30
2.2	Example of Manual Insertion Analysis	31
2.3	Alpha ( $\alpha$ ) and Beta ( $\beta$ ) rotational symmetries for various parts	32
2.4	Example of Manual Handling Analysis	37
2.5	Example of Manual Fitting Analysis	38
2.6	Assemblability Evaluation Score	41
3.1	Boothroyd Dewhurst DFA manual Analysis	50
3.2	Lucas DFA manual analysis	52
4.1	The Bill of Material (BOM) of Normal Parts in MPOC	57
4.2	The Bill of Material (BOM) of Purchased Parts in MPOC	58
4.3	The Picture of Normal Parts in MPOC	59
4.4	The Picture of Purchased (Standard) Parts in MPOC	63
4.5	The Cycle Time of Current Base Panel	83
4.6	The Estimated Cycle Time of Improvement Base Panel	83
4.7	The Cycle Time of Current MDF Compartment	85
4.8	The Estimated Cycle Time of Improvement MDF Compartment	86
4.9	The Cycle Time of Current Battery Compartment	88
4.10	The Estimated Cycle Time of Improvement Battery Compartment	88
4.11	The Cycle Time of Current Rectifier Compartment	91

4.12	The Estimated Cycle Time of Improvement Rectifier Compartment	91
4.13	The Cycle Time of Current Top Part	94
4.14	The Estimated Cycle Time of Improvement Top Part	94
4.15	Description of the Column in TeamSET Analysis Window	99
4.16	Description of the Symbol in Assembly Flowchart Area	102
4.17	Description of DFA Analysis Summary Window	105
4.18	DFA Analysis Result for Current Base Panel	106
4.19	DFA Analysis Result for Improvement Base Panel	107
4.20	DFA Analysis Result for Current MDF Compartment	110
4.21	DFA Analysis Result for Improvement MDF Compartment	111
4.22	DFA Analysis Result for Current Battery Compartment	114
4.23	DFA Analysis Result for Improvement Battery Compartment	115
4.24	DFA Analysis Result for Current Rectifier Compartment	118
4.25	DFA Analysis Result for Improvement Rectifier Compartment	119
4.26	DFA Analysis Result for Current Top Part	122
4.27	DFA Analysis Result for Improvement Top Part	123
5.1	The Total Cycle Time for each Compartment	127
5.2	DFA Analysis Result for each Compartment	129
5.3	Total Net Reduction of Current and Improvement MPOC	130
5.4	Design Changes and Associated Reduction of MPOC	133

## LIST OF ABBREVIATIONS

AEM	-	Assembly Evaluation Method
ASF	-	Assembly Sequence Flowchart
BD	-	Boothroyd Dewhurst
BOM	-	Bill of Materials
CAD	-	Computer-Aided Design
CR	-	Chromium
DFA	-	Design for Assembly
DFM	-	Design for Manufacture
DFMA	-	Design for Manufacture and Assembly
DIA	-	Diameter
EG	-	Electro Galvanized
PCS	-	Pieces
PDS	-	Product Design Specification
QTY	-	Quantity
R & D	-	Research and Development
SS	-	Stainless Steel
TM	-	Telekom Malaysia
WIP	-	Work Instruction Procedure

# **CHAPTER 1**

## **INTRODUCTION**

### **1.1 Introduction**

Outdoor Telecommunication Cabinets also known as TM Multi Purpose Outdoor Cabinet (MPOC) in production line is to house the telephone equipment, such as the channel banks that are used to carry out analog-to-digital and digital-to-analog conversion between subscriber lines and telephone company lines. Importantly, outdoor telecommunication cabinets are often used to protect sensitive electronic equipment from tempering, vandalism and adverse environmental conditions. Some organizations and company that involved in making this product have in past used different methods for establishing the critical issues in a product design and as a results, focused their efforts for improving the productions. In manufacturing industrial sector, a company must take into account the many factors that affect the choice of assembly method when considering the manufacture of a product to improve the productivity. The problem in designing the product is how to maximize the use of manufacturing processes in production line and how to minimize the number of components of products in assembly processes, so that the total cost of manufacture and assembly is minimal.



**Figure 1.1** : TM Multi Purpose Outdoor Cabinet (MPOC)

Each process involves material set up and subsequent change by a person or a machine and is called a manufacturing operation. Each manufacturing operation takes time and has an associated cost. Assembly is an important part of the overall manufacturing process. Assembling a product means that a person or a machine must retrieve finished components from storage, handle the components to orient them relative to each other, and mate them. Each act of retrieving, handling, and mating a component is called an assembly operation. Each assembly operation takes time and has an associated cost. The assembly of components can form a significant part of the manufacturing cost of a product, especially when large quantities of components are involved.



Through this, there are many ways or method for analysis design that can be used for improving an existing products. In addition, the method nowadays has developed with a computerized version which allowed its implementation in a broad range of companies. There are many manufacturing company of significant savings obtained through the application of software which provide more reliable, easy to use, and high efficiency. In conjunction with the application, designers can make use of DFMA guidelines to help manage and reduce the large amount of information involved. The use of these guidelines have not only brought significant cost savings and improvements in quality and reliability to the manufacture of many products, they have also helped to shorten their time-to-market (Boothroyd, 1994).

## **1.2 Project Background**

This project strives to make an improvement of design for assembly processes for TM Multi Purpose Outdoor Cabinet (MPOC) in TAIACE Engineering Sdn. Bhd. (TESB). Basically, this project is conducted accordingly to the process flow chart as shows in Figure 1.2. The initial step is the confirmation of the project title which is improvement in assembly process of TM Multi Purpose Outdoor Cabinet (MPOC) using DFMA and DFA analysis. Second step is to identify a company (TESB) to carried out the case study. After that, a few visits to the company in order to gain the overall idea on the assembly operation and management system in production line.

Objectives and scopes of the projects need to be identified to concentrate and limit the study areas. Then, relevant data and information related with product, DFMA and DFA are collected simultaneously from the company and other resources such as internet, library, book, and etc. Search the journal and articles that related with DFMA and DFA concept and methodology as the references. Next, determined DFA methodology to be use for analysis the ease of assembly of the products or subassemblies it designs with consideration of project needs to state the objective and scope. Both of Boothroyd Dewhurst DFA methodology and Lucas DFA methodology will be testing principles

with same product (multi ink mechanical pen) to make sure which method provide quick results, effective and easy to use. This step done to determine which methodology will be used in the analysis process. After that, analyzed the assembly current parts design product based on the DFA terminology. The tools that used is Lucas DFA software (TeamSET V3.1) as the design for assembly analysis method and Autodesk Inventor 2009 software for designing the development new product.

Next step is to compare the design efficiency of current assembly parts product with the new improvement assembly parts product due to ease assembly with minimal time. If the result achieved the objective of the analysis which is reduce the number of parts and assembly time, so all the data will analyzed in term of assembly process to proposed the new development parts design of the product. In fact, if the result did not achieve the aim of analysis which is reduced cost and in shorter time, reanalysis the product due to the same method. **Appendix A** represents the Gantt Chart of this project.