



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**Redesign of a Manual Wheelchair
Through
Concurrent Engineering Tools**

**Thesis submitted in accordance with the requirements of the Universiti
Teknikal Malaysia Melaka for the Bachelor Degree of Manufacturing
Engineering in Manufacturing Design**

By

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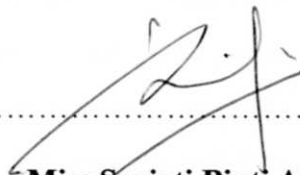
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APPROVAL

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ABSTRACT

This report describes about the implementation of redesign the manual wheelchair by using the application of concurrent engineering. The scope based on the existing wheelchair design and the appropriate application of Concurrent Engineering (CE) tools. The method used for gaining the data was from the survey done by distributing of questionnaires to several numbers of people and the wheelchair user. From the data achieved, it can be classified into several categories to be studied. Data will be analyzed by using the Quality Function Deployment (QFD) method to verify the highest rank from the people and customer requirements. The new proposed design of wheelchair was drawn using SolidWorks software based on the QFD result achieved. In the same time, both design and redesign of manual wheelchair were analyzed by using the Design for Assembly (DFA) tools which is TeamSET software, to compare the design efficiency to achieve the objectives of the project. Result shown that the design efficiency for redesign manual wheelchair obtained better percentage rather than the existing design. From the study, even the redesign possesses a greater number of part compared to the existing design, it still has the advantages based on the convenience functions and the percentage of design efficiency. Eventually, the improvement of wheelchair design finally will be able to meet user requirements and satisfactions.

ABSTRAK

Kertas kerja ini menghuraikan tentang pelaksanaan dalam mereka bentuk semula kerusi roda manual dengan menggunakan aplikasi Kejuruteraan Serentak. Skop projek adalah memfokus kepada rekabentuk asal kerusi roda dan disertakan dengan aplikasi Kejuruteraan Serentak. Kaedah yang digunakan untuk mendapatkan data adalah daripada tinjauan dengan mengagihkan borang soal selidik terhadap segolongan individu dan juga kepada pengguna kerusi roda sendiri. Hasil data yang telah diperolehi akan dikelaskan kepada beberapa kategori sebelum analisa dilakukan. Kemudian, kesemua data tersebut akan dianalisa dengan menggunakan kaedah QFD (Quality Function Deployment) untuk mengelaskan kepentingan, keperluan dan kehendak pengguna. Daripada keputusan yg telah diperolehi, rekabentuk kerusi roda yang baru akan dilukis dengan menggunakan perisian SolidWorks. Dalam pada masa yang sama, kedua- dua rekabentuk kerusi roda sebelum dan selepas direkabentuk tersebut akan dianalisa dengan menggunakan perisian TeamSET, salah satu perkakasan daripada DFA (Design for Assembly) untuk membandingkan keputusan yang diperolehi sebagai pencapaian objektif projek. Hasil daripada kajian mendapati bahawa kecekapan rekabentuk untuk rekabentuk semula menghasilkan peratusan yang lebih tinggi berbanding dengan rekabentuk asal. Walaupun rekabentuk semula mempunyai nilai bahagian yang lebih banyak berbanding dengan rekabentuk asal, namun begitu rekabentuk semula tetap mempunyai kelebihan dari segi kemudahan fungsi dan peratusan kecekapan rekabentuk. Akhirnya, pembaikan rekabentuk kerusi roda akan mampu untuk memenuhi kehendak dan kepuasan khususnya para pengguna.

ABSTRAK

Kertas kerja ini menghuraikan tentang pelaksanaan dalam mereka bentuk semula kerusi roda manual dengan menggunakan aplikasi Kejuruteraan Serentak. Skop projek adalah memfokus kepada rekabentuk asal kerusi roda dan disertakan dengan aplikasi Kejuruteraan Serentak. Kaedah yang digunakan untuk mendapatkan data adalah daripada tinjauan dengan mengagihkan borang soal selidik terhadap segolongan individu dan juga kepada pengguna kerusi roda sendiri. Hasil data yang telah diperolehi akan dikelaskan kepada beberapa kategori sebelum analisa dilakukan. Kemudian, kesemua data tersebut akan dianalisa dengan menggunakan kaedah QFD (Quality Function Deployment) untuk mengelaskan kepentingan, keperluan dan kehendak pengguna. Daripada keputusan yg telah diperolehi, rekabentuk kerusi roda yang baru akan dilukis dengan menggunakan perisian SolidWorks. Dalam pada masa yang sama, kedua- dua rekabentuk kerusi roda sebelum dan selepas direkabentuk tersebut akan dianalisa dengan menggunakan perisian TeamSET, salah satu perkakasan daripada DFA (Design for Assembly) untuk membandingkan keputusan yang diperolehi sebagai pencapaian objektif projek. Hasil daripada kajian mendapati bahawa kecekapan rekabentuk untuk rekabentuk semula menghasilkan peratusan yang lebih tinggi berbanding dengan rekabentuk asal. Walaupun rekabentuk semula mempunyai nilai bahagian yang lebih banyak berbanding dengan rekabentuk asal, namun begitu rekabentuk semula tetap mempunyai kelebihan dari segi kemudahan fungsi dan peratusan kecekapan rekabentuk. Akhirnya, pembaikan rekabentuk kerusi roda akan mampu untuk memenuhi kehendak dan kepuasan khususnya para pengguna.

DEDICATION

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TABLE OF CONTENTS

Abstract.....	i
Abstrak.....	ii
Dedication.....	iii
Acknowledgements.....	iv
Table of Contents.....	v
List of Figures.....	ix
List of Tables.....	xi
List of Sign and Symbol.....	xii
1.0 INTRODUCTION.....	1
1.1) General Introduction.....	1
1.2) Objective	2
1.3) Problem Statement.....	2
1.4) Scope of Project.....	3
2.0 LITERATURE REVIEW.....	4
2.1) Introduction.....	4
2.2) Wheelchair development.....	5
2.2.1) Market research and industrial surveys.....	6
2.2.2) Classes of Manual Wheelchairs.....	6
2.2.3) Existing manual wheelchairs design	10
2.2.4) Wheelchair Common Materials.....	13
2.2.5) Advantages of manual wheelchairs.....	14

2.3) Concurrent Engineering.....	15
2.3.1) Definition of Concurrent Engineering.....	16
2.3.2) Objectives of Concurrent Engineering.....	17
2.3.3) Fundamental of Concurrent Engineering.....	18
2.3.4) Advantages of CE.....	19
2.3.5) Concurrent Engineering Tools	20
2.3.5.1) Quality Function Deployment (QFD).....	20
2.3.5.2) Design For Assembly (DFA).....	22
2.3.6) TeamSET.....	30
3.0 METHODOLOGY.....	33
3.1) Method of study.....	33
3.2) Project Flow Chart for PSM 1.....	34
3.2.1) Explanation on Project Flow.....	35
3.3) Project Flow Chart for PSM 2.....	36
3.2.1) Explanation on Project Flow.....	37
4.0 QFD IMPLEMENTATION.....	38
4.1) Introduction to QFD.....	38
4.2) QFD Project Case Study.....	39
4.3) Methodology Implementation of QFD.....	40
4.4) Construction QFD Matrix.....	41
4.4.1) Customer Requirement Section.....	42
4.4.2) Planning Matrix Section.....	42

4.4.3) Technical Requirement section.....	43
4.4.4) Interrelationship Section.....	43
4.4.5) Roof Section.....	45
4.4.6) Target Section.....	46
4.4.7) Propose New Concept.....	46
4.5) Gathering Information from VOC.....	47
4.5.1) Questionnaire Objective.....	48
4.5.2) Result From Questionnaire.....	48
4.5.3) User Background.....	49
4.5.4) Graph Analysis.....	50
4.5.5) Scales of Rating.....	54
4.5.6) Complaint.....	56
4.5.7) Technical Requirement Section.....	57
4.6) Final Construction HOQ.....	60
4.6.1) Result of Priority Tech. Requirement of Man. Wheelchair.....	62
5.0 DFA ANALYSIS.....	63
5.1) Introduction of DFA Analysis.....	63
5.2) Implementation of DFA Analysis.....	64
5.3) Methodology Implementation on DFA Analysis.....	65
5.3.1) TeamSET Process Flow.....	66
5.3.2) TeamSET Database Process Flow.....	67
5.4) Exploded Parts of Man. Wheelchair.....	71

5.4.1) Frame of Wheelchair.....	71
5.4.1.1) Brake.....	72
5.4.2) Supporting Parts.....	73
5.4.3) Driving Parts.....	75
5.4.3.1) Caster.....	76
5.4.3.2) Rear Tyre.....	77
5.5 TeamSET Analysis.....	78
5.5.1 Existing Manual Design Analysis.....	78
5.6 Drawing Proposal.....	83
5.6.1 Exploded Parts of Redesign Man. Wheelchair.....	84
5.6.1.1 Frame of Wheelchair.....	84
5.6.1.2 Supporting Parts.....	85
5.6.1.3 Driving Parts.....	86
5.7 Redesign Proposal Analysis Using TeamSET.....	87
6.0 DISCUSSION.....	92
6.1 Discussion of QFD Result.....	92
6.1.1 Design Improvement of Wheelchair.....	93
6.2 Discussion on DFA (TeamSET).....	97
7.0 CONCLUSION.....	100
8.0 FURTHER WORK.....	101
8.1 Further work.....	101

REFERENCE.....102

APPENDICES

A	Gantt Chart for PSM 1 & 2
B	Standard Wheelchair and Main Components
C	Questionnaire Form
D	Detail Drawing for Redesign Manual Wheelchair
E	TeamSET Result Sheets

LIST OF FIGURES

2.2	Civil War wheelchair	5
2.2.2	Side view schematic of wheelchair	9
2.2.3	Standard wheelchair and main components	10
2.3.5.2.a	Pressed or molded parts (before and after)	23
2.3.5.2.b	Building in self-fastening features	24
2.3.5.2.c	Decrease ambiguity in part/subassembly orientation	25
3.2	Flow Chart of job planning	34
3.3	Flow Chart of job planning	36
4.2	Process Flow of QFD Implementation	39
4.4	Basic Element HOQ	41
4.4.1	Basic of HOQ Customer Requirement	42
4.4.2	Basic of HOQ of Matrix Selection	42
4.4.3	Example of Tech. Requirement	43
4.4.4.a	Example of Relationship	44
4.4.4.b	Common Relationship Values	44
4.4.5.a	Co relationship symbol	45
4.5.4.a	Gender	50
4.5.4.b	Age	51
4.5.4.c	Purpose using wheelchair	52
4.5.4.d	Usage Duration	53

4.5.7	Major Component on Present Wheelchair	58
5.3.1	The process flow in developing TeamSET database	66
5.3.2.a	Product maintaining projects, products and design scenarios	67
5.3.2.b	Product Breakdown Structure	68
5.3.2.c	Assembly window	69
5.3.2.d	DFA analysis for assembly parts	70
5.4.1	Tree Structure of Main frame	71
5.4.1.1	Tree Structure of Brake	72
5.4.2	Tree Structure of Supporting Part	73
5.4.3	Tree Structure of Driving Part	75
5.4.3.1	Tree Structure of Caster	76
5.4.3.2	Tree Structure of Rear Tyre	77
5.5.1.a	Summary result for Frame Part	78
5.5.1.b	Summary result for Driving Part	79
5.5.1.c	Summary result for Supporting Part	81
5.6	Design proposal of Manual Wheelchair	83
5.6.1.1	Tree Structure of Frame	84
5.6.1.2	Tree Structure Supporting Part	85
5.6.1.3	Tree Structure for Driving Parts	86
5.7.a	TeamsSET analysis for Frame part	87
5.7.b	TeamsSET analysis for Driving parts	88
5.7.c	TeamsSET analysis for Supporting parts	90
6.1.1.a	Adjustability of Armrest	93

6.1.1.b	Height Adjustability	94
6.1.1.c	Adjustability of Footrest	95
6.1.1.d	Adjustability of Footrest	95
6.1.1.e	Adjustability of Backrest and Seat	96

LIST OF TABLES

4.5.3	Summary of wheelchair user background	49
4.5.5	Scales of Rating	54
4.5.5.b	Summary of Responses Importance from Respondent	55
4.5.6	Number of Complaint	56
4.5.7.a	Main Component of Manual Wheelchair	57
4.5.7.b	Technical Requirement	59
4.6	Priority Technical Requirement	61
5.4.1	Parts consists of frame	72
5.4.1.1	Brake Parts	73
5.4.2	Parts consists of Supporting Parts	74
5.4.3.1	Parts consists of Caster Tyre	76
5.4.3.2	Parts consists of Rear Tyre	77
5.5.1.a	Summary analysis for Frame	79
5.5.1.b	Summary analysis for Driving parts	80
5.5.1.c	Summary analysis for Supporting parts	82
5.7.a	Summary analysis for Frame	88
5.7.b	Summary analysis Driving Parts	89
5.7.c	Summary analysis for Supporting Parts	91
6.2	Comparison of Existing and Redesign Wheelchair	98

SIGNS & SYMBOLS

CE	:	Concurrent Engineering
QFD	:	Quality Function Deployment
HOQ	:	House of Quality
DFA	:	Design for Assembly
VOC	:	Voice of Customer
PSM	:	Projek Sarjana Muda

CHAPTER 1

INTRODUCTION

1.1 General Introduction

Product lifecycle is being reduced drastically due to rapid changes in technology and customer requirements. To enable product lifecycle to be reduced, Concurrent Engineering (CE) technique needs to be applied. Currently, the implementation of Concurrent Engineering (CE) tools are applied either manually or computer-aided. Most of the applied interested in implementing CE are hindered by lack of clear guidelines or procedures and no integration of isolated design and manufacturing teams. The objective of the project is to integrate some CE tools in analyzing a product to get the full benefit of the implementation. The advantages of the integration are to decrease the number of part design and indirectly to reduce cost and time. At the same time, it fulfills customer's requirement.

In this project, CE has been applied in developing the manual wheelchair. Generally, there are many types of wheelchair exist in market nowadays. Some of them were designed to suit the requirements especially to the users in such many ways and purposes. But the fact is how many of the designs are totally suited to the customer's needs? To attain the best design with the lowest cost of manufacturing is not an easy task, but with the application of CE tools, the problems could be minimized. Besides that, the design also must be concerned to

the customer needs and requirements in order to achieve high rank of market selling.

1.2 Objective

Wheelchair has an important role in order to help disable people to allow a greater mobility by decreasing their limitations of travel. The objectives of this project are as follows:

- a) To redesign and improve existing design of wheelchair by applying the concurrent engineering method.
- b) To identify the customer requirements and needs regarding product to be studied.
- c) To achieve the better design efficiency for redesign product compared to the existing product.

1.3 Problem Statement

Nowadays, the manufacturing industries are concerned about producing a high quality product with the lowest cost. So, this is the major key in business to gain high profit and succeed. To achieve the goal, most industries applied the CE tools in developing their products.

In present, there are many types of wheelchair exist in market place. They were designed in such many ways and purposes. Some of them were designed with well good looking and some of them just with simple design. But did we realize that certain parts of the wheelchair are just being design without any purposes? Instead to make the wheelchair look more gorgeous and nice looking. It is not necessary to design a product with a good looking shape, but lack of purposes.

Another problem also encountered, the design of the wheelchair is too complicated with some unnecessary parts available. Sometimes the parts are difficult to handle and the design can be considered as a failed design.

This project focused on the development of a wheelchair design by applying the CE tools. Thus, to overcome the problems encountered, this project will run through appropriate CE tools in the chapter 4 and 5 ahead.

1.4 Scope of Study

i. Case study

A wheelchair has been selected as a case study for this project and had the potential to be redesigned by applying the appropriate CE tools.

ii. Design Tool (SolidWorks Software)

The tool selected for drawing the wheelchair is SolidWork. Users can easily generate drawings from a model. Photorealistic renderings and animations that allow communicating how future products will look and perform early in the development cycle

iii. Quality Function Deployment (QFD)

QFD will be used to identify customer requirement. It will be done through a survey. The basic idea is to translate customer's requirement into the appropriate technical requirement for each stage of product development and production.

iv. Design for Assembly (DFA) – TeamSET

DFA is a systematic methodology that reduces manufacturing costs, total number of parts in a product, and etcetera. For this project, the software called TeamSET is used to analyze the design efficiency for both existing and redesign manual wheelchair.

CHAPTER 2

LITERATURE REVIEWS

2.1 Introduction

To develop this project, there are certain important CE tools that have been applied such as Quality Function Deployment (QFD) and Design for Assembly (DFA). These two important CE tools are very useful especially to the industry. This chapter described about the history of wheelchair, the definition of concurrent engineering and the approach of QFD and DFA, including the application of the engineering software called TeamSET.

2.2 Wheelchair Development

Wheelchairs in one form or another have been in use for many centuries, with one of the earliest models recorded by an engraving on a Chinese sarcophagus dated 6 AD. Self propelling chairs were a later invention, but by the time of the American Civil War records show that the war wounded used wooden chairs (figure 2.2) with large front wheels and small rear casters [2].

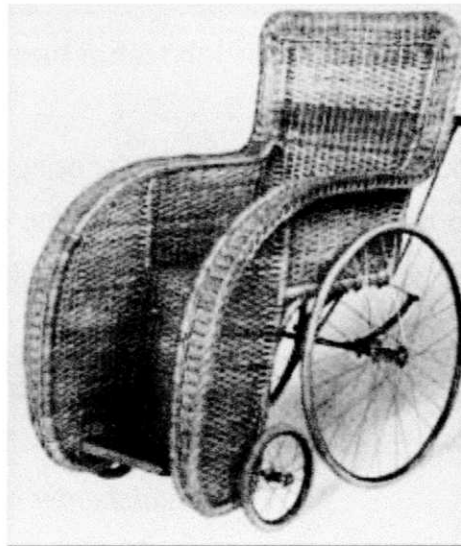


Figure 2.2: Civil war wheelchair

Over the years, changes in design and structure reflected the introduction of new materials, advances in medical science, improvements in access and the environment and changes in social attitudes.

The arrival of the automobile resulted in demand for a portable model. In 1932, following a mining accident, Herbert A. Everest, an American mining engineer, collaborated with Harry C. Jennings, a mechanical engineer, to design and manufacture a relatively 'light-weight' folding wheelchair.