



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**Design of Wheelbarrow for Construction Industry Utilizing  
Ergonomics Analysis and QFD**

Report submitted in accordance with the requirement of the  
Universiti Teknikal Malaysia Melaka for the Bachelor Degree of Manufacturing  
Engineering in Manufacturing Process

BY

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## UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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JUDUL: Design of Wheelbarrow Utilizing Ergonomic Analysis and QFD for Construction Industry

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Signature : .....

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Date : 20 May 2008

## **APPROVAL**

This PSM submitted to the senate of UTeM and has been as partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Process).

The members of the supervisory committee are as follow:

.....  
(MUHAMMAD HAFIDZ FAZLI BIN MD FAUADI)  
(Main Supervisor)

## **ABSTRACT**

This project is all about the important of ergonomic specification for handling application in designing of wheelbarrow. The observation and analysis the wheelbarrow must be considered such as the existing design for wheelbarrow can be produced to improve the material, provide comfortable, safe and user friendly to worker. QFD is the primary focus is getting the information necessary for determining what customer truly wants. It also can reduce the overall cycle time in bringing a product to market. It must be focus on ergonomic concern how they handle and used the wheelbarrow. Before produce the new design, take all the data that related with ergonomic and purpose to concentrate for this matter of functionality. The questionnaire, interviews and survey from data will be discussed to relate with QFD capture software. Finally, make the new design was analyze by using RULA and Push Pull and Lift Lower analysis using CATIA software.

## **ABSTRAK**

Projek ini adalah berkisarkan tentang kepentingan aspek perincian dalam ergonomik untuk diaplikasikan dalam reka bentuk “wheelbarrow”. Analisis pada wheelbarrow mestilah mempertimbangkan kepada reka bentuk luaran pada “wheelbarrow” yang boleh dihasilkan untuk membaiki bahan asas, memberikan keselesaan dan keselamatan kepada pekerja. QFD adalah fokus yang utama yang membolehkan kita mendapat keperluan dan maklumat untuk menentukan apakah sebenarnya kehendak pelanggan. Ianya juga boleh mengurangkan proses keseluruhan masa untuk membawa produk di dalam pasaran. Ia mesti ditumpukan pada ergonomik bagaimana mereka mengendalikan ataupun menggunakan “wheelbarrow”. Sebelum menghasilkan produk yang baru, kumpul semua data yang berkaitan dengan ergonomik dan beri tumpuan pada fungsinya. Data- data melalui soalan- soalan, seisi temuramah dan tinjauan akan dibincangkan dan kaitkan dengan menggunakan software QFD. Akhir sekali, hasilkan rekabentuk baru dan dianalisis menggunakan RULA dan Push Pull dan Lift Lower analisis yang terdapat dalam software CATIA.

## **DEDICATION**

To my beloved parent, family, lecturers and friends

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# TABLE OF CONTENTS

Declaration.....	ii
Approval.....	iii
Abstract.....	iv
Abstrak.....	v
Dedication.....	vi
Acknowledgements.....	vii
Table of Contents.....	viii
List of Figures.....	xiii
List of Tables.....	xvii
List of Abbreviations, Symbols, Specialized Nomenclature.....	xvii
<b>1.0 INTRODUCTION.....</b>	<b>1</b>
1.1 Background of project.....	1
1.2 Problem statement.....	2
1.3 Objectives.....	3
1.4 Scope of project.....	3
<b>2.0 LITERATURE REVIEW.....</b>	<b>4</b>
2.1 Introduction.....	4
2.2 Definition of Ergonomic.....	4
2.3 Human factors.....	6
2.4 Risk and personal factors.....	9
2.4.1 Risk factor for musculoskeletal disorders in the workplace.....	9
2.4.2 Musculoskeletal pain.....	10
2.4.3 Personal factors affecting strength.....	12
2.5 Manual material handling.....	13
2.5.1 Reducing the risk of MMH overexertion.....	14

2.5.2	Job design.....	14
2.6	Definition of Quality Function Deployment (QFD).....	15
2.6.1	History of QFD.....	16
2.6.2	The benefits of Quality Function Deployment (QFD).....	18
6.7	What is House of Quality (HOQ).....	20
2.8	The Four Phases of QFD.....	24
2.8.1	The Objective of QFD.....	25
2.9	Design.....	30
2.10	Example how to design wheelbarrow.....	30
2.10.1	Raw Materials.....	30
2.10.2	The Manufacturing Process.....	30
2.10.3	Tray component.....	31
2.10.4	Leg and braces component.....	32
2.10.5	Tire and wheel component.....	33
2.10.6	Handle component.....	34
2.10.7	Packaging and shipping.....	34
2.10.8	Quality Control.....	34
2.10.9	The Future.....	35
2.11	Ergonomic design for wheelbarrow.....	36
2.12	Wheelbarrow.....	38
2.12.1	History.....	38
2.12.2	Types.....	39
2.12.3	Location.....	39
2.13	Conclusion.....	41
<b>3.0</b>	<b>METHODOLOGY.....</b>	<b>42</b>
3.1	Introduction.....	42
3.2	Information resources.....	45
3.3	Tool.....	45
3.3.1	CATIA Software.....	45
3.3.2	QFD Software.....	45

3.4	Collect the data.....	46
3.4.1	Questionnaire.....	47
3.4.2	Characteristic of wheelbarrow.....	47
3.5	Building House of Quality.....	47
3.6	Afford the new design.....	47
3.7	Ergonomic requirement.....	47
3.7.1	Anthropometric data.....	47
3.7.2	Posture Analysis.....	48
3.8	RULA Analysis.....	48
3.9	PUSH/ PULL Analysis.....	48
3.10	NIOSH Lifting Analysis.....	48
3.11	Conclusion.....	50
4.0	<b>CASE STUDY</b> .....	50
4.1	Introduction.....	50
4.2	General Information.....	51
4.3	Data collection.....	51
4.3.1	Gender, age and material of wheelbarrow.....	51
4.3.2	Working hour per day.....	51
4.3.3	Duration time for worker used a wheelbarrow as long as they work at construction area.....	52
4.3.4	To measure how frequent the worker used the wheelbarrow per day.....	52
4.3.5	The problem while the worker used the wheelbarrow.....	53
4.3.6	Ergonomic specification.....	54
4.3.7	Get the advice or attend form doctor.....	55
4.3.8	Distance.....	56
4.3.9	Work load.....	57
4.4	Conclusion.....	58

<b>5.0 DESIGN</b> .....	60
5.1 Introduction.....	60
5.2 Design specification first design.....	60
5.3 Design specification second design.....	61
5.4 Conclusion.....	66
<b>6.0 RESULTS AND DISCUSSION</b> .....	67
6.1 Introduction.....	74
6.2 First Step of QFD.....	76
6.3 Second Step of QFD.....	80
6.4 Third Step of QFD.....	84
6.5 QFD Analysis.....	88
6.6 RULA Analysis.....	88
6.6.1 The analysis method of Action Level Legend.....	88
6.6.2 Step by step how to setting the data info into the manikin.....	89
6.6.3 RULA Analysis Posture 1.....	91
6.6.4 RULA Analysis Posture 2.....	86
6.6.5 RULA Analysis Posture 3.....	89
6.7 Push Pull Analysis.....	97
6.7.1 Push Pull Analysis Posture 1.....	97
6.8 Lift Lower Analysis.....	99
6.8.1 Lift Lower Analysis Posture 2.....	99
6.9 Conclusion.....	104
<b>7.0 CONCLUSION AND RECOMMENDATION</b> .....	106
7.1 Further work and recommendation.....	107

## **APPENDICES**

- A Gantt Chart PSM 1
- B Gantt Chart PSM 2
- C Sample of Questionnaire
- D Approval Letter 1
- E Approval Letter 2

## LIST OF FIGURES

2.1	The Relationship of Ergonomic	5
2.2	Factors and usability of manual vehicle	9
2.3	Area of Back Frequently Injured by Lifting Activities	11
2.4	Distribution of static strength for males and females illustrating the degree of overlap between the two distributions	12
2.5	Maximum isometric strength for five muscle groups as a function of age	13
2.6	Origin of name	16
2.7	QFD Benefit	18
2.8	Six sections when we want to build House of Quality	20
2.9	Basic house of quality matrix HOQ	22
2.10	Step four phase of QFD	24
2.11	Japanese QFD Symbols.	28
2.12	Target Goal symbols.	29
2.13	Correlation Matrix Symbols.	30
2.14	Using the Correlation Matrix to determine relationships among <i>How's</i> .	30
2.15	The part name of wheelbarrow	32
2.16	The Compact Solutions “Compact Folding Wheelbarrow”	36
2.17	Ergonomic specification for NuBarro	37
2.18	Traditional wheelbarrow	38
2.19	Mixing concrete into wheelbarrow	39
2.20	Forking the mulch into the wheelbarrow	40
2.23	Carrying nut bunches by using wheelbarrow	40
3.1	Flow chart above show the project selection	43
3.2	Process flow of project	44
4.1	The working hour per day of worker	51
4.2	Duration time for worker used the wheelbarrow	52
4.3	To measure how frequent the worker used the wheelbarrow per day	53
4.4	The list of problem while they used the wheelbarrow	54
4.5	The part of body affected in handling the wheelbarrow	55
4.6	Get the advice or attend from doctor	56
4.7	The working distance over the number of workers	57
4.8	The work load over the number of worker	58
4.9	The posture of worker without and with handling the object on wheelbarrow	59
4.10	The construction area	59
5.1	The first design of wheelbarrow	60

5.2	The second design for ergonomic wheelbarrow	62
5.3	The features of second design	63
5.4	The Multi purpose use of wheelbarrow	64
5.5	The drafting for second design	65
6.1	Graph duration time of employee work at construction area	67
6.2	The graph working hour per day	68
6.3	The graph of frequently used wheelbarrow per day	68
6.4	The graph material of wheelbarrow	69
6.5	The charts of worker feel pain and uncomfortable	70
6.6	The graph parts of body always feel pain and uncomfortable	70
6.7	The chart of worker get the advice form doctor	71
6.8	The distance of wheelbarrow	72
6.9	The chart for heavy mass of wheelbarrow	73
6.10	The House of Quality	74
6.11	The four steps in QFD	75
6.12	First steps House of Quality	76
6.13	The Whats vs Hows list in first step House of Quality	77
6.14	The report shows the result of the Technical and Customer Requirement for the first step	79
6.15	Second step of House of Quality	80
6.16	The Whats vs Hows list in second step House of Quality	80
6.17	The report shows the result of the Part Characteristic for second step	83
6.18	Third step of House of Quality	84
6.19	The Whats vs Hows list in third step House of Quality	84
6.20	The report shows the result of the Process manufacturing for the third step	85
6.21	The correlation matrices symbol	87
6.22	The comparison first design and second design	89
6.23	Setting the manikin name and gender	89
6.24	Setting the optional	90
6.25	Process flow for analysis	91
6.26	The result from the RULA Analysis for 10 kg	92
6.27	The result from the RULA Analysis for 50 kg	92
6.28	The final score from RULA Analysis for 80 kg	93
6.29	The minimum load of wheelbarrow	94
6.30	The result for RULA Analysis Posture 2	94
6.31	The maximum load for Posture 2	95
6.32	The result RULA Analysis for first design	95
6.33	Shows the RULA Analysis for minimum load	96
6.34	The RULA Analysis for Posture 3	96
6.35	The maximum load for Posture 3 is 80 kg	97
6.36	The result show the Push Pull Analysis	98
6.37	The data from Push Pull Analysis	98
6.38	The final score from push pull analysis	99
6.39	Show the result for Lift Lower Analysis Posture 2	100

6.40	The specification object weight is 50 kg	101
6.41	The maximum object weight to lifting the load	102
6.42	Shows the Lift Lower Analysis	102
6.43	The weight of object is 50 kg	103
6.44	The final and maximum weight of wheelbarrow	103



## **LIST OF TABLES**

2.1	History of QFD	16
4.1	Time working and amount of worker	51
4.2	Duration time for worker used a wheelbarrow	52
4.3	To measure how frequent the worker used the wheelbarrow per day	53
4.4	The list of problem while they used the wheelbarrow	54
4.5	The part of body and number of worker	55
4.6	They get the advice or attend from the doctor	56
4.7	The working distance over the number of employees	56
4.8	The work load over the number of workers	57
5.1	Technical specification first design	61
5.2	Technical specification second design	64

## **LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE**

QFD	-	Quality Function Deployment
HOQ	-	House of Quality
RULA	-	Rapid Upper Limb Assessment
VOC	-	Voice of Customer
NIOSH	-	National Institute for Occupational Safety and Health
MITC	-	Malacca International Trade Centre

# CHAPTER 1

## INTRODUCTION

### 1.1 Background of project

Based on Anonymous (2007a), it notes that construction industry is one of the most dangerous occupations. The worker uses manual handling to lift, hold, carry, push and pull to move, assemble and store the material. There are many types of manual handling such as wheelbarrow, pulley, and so on.

Wheelbarrow is a small hand propelled vehicle, usually having only one or two wheel that consisting of a tray bolted to two handles and two legs. It is designed to push and pull using two handles and controlled by one worker. It will be exposure to many of documented risk factors for low back disorders. It is important for ergonomic analysis to come out the design for wheelbarrow that can be produced to change and improved the user convenience, safety and user friendly to worker.

By using QFD method, the primary focus is getting the information necessary for determining what customer truly wants. It is can reduce the overall cycle time in bringing a product to market. It must be focus on ergonomic concern how they handle and used the wheelbarrow. Before produce the new design, we must take all the data, analyze it purpose and concentrate to this matter of functionality. Then, used the CATIA and Ergonomic Analysis to redesign the new wheelbarrow that comfortable and match with entire Asian worker such as Malaysian, Indonesian, and Indian and so on.

## 1.2 Problem statement

To redesign a good wheelbarrow, we used QFD method to overcome the problem from user. So, this project will analyze and study about the ergonomic aspects and QFD to redesign the wheelbarrow. In correct design where anthropometric data were ignored can cause psychological discomfort, physical fatigue and could be harmful and damaging in the long term. When we use QFD method, the customer requirement can be translated to provide product developers with a systematic method for the voice of customer into product design.

Carrying, push, pull and lifting the material at the construction area is really hard work. It requires a tremendous of bending, pulling and twisting activities that is repetitive works (Anonymous, 2006). Worker back and hands get tired and fatigue which could result in injury. Pushing the material in an awkward spaces or poor weather condition, can further increase the risk of injury.

However, to design wheelbarrow, it must be able to fulfill the ergonomic aspect including the anthropometric issues and safety issues. Then, list down what customer want to carry and the total of load while they carry the wheelbarrow. Finally, calculate the life and force of wheelbarrow.

### **1.3 Objectives**

Overall, this project is all about the ergonomic aspect and QFD method to understand what the customers want. The wheelbarrow must be designed and relate with right posture for handle it and the load will carry on. It made can influence the productivity and the efficiency of application on industry.

- (a) To determine users requirement regarding the design of material handling device with regards to aesthetic aspects.
- (b) To analyze the ergonomic requirements for material handling equipment in construction industry.
- (c) To propose a design of material handling device that fulfill the ergonomic requirement.

### **1.4 Scope of project**

The scopes of this project are as follow:

- (a) The project uses wheelbarrow as an example for manual material handling.
- (b) To obtain the dimension of human body and analysis about the wheelbarrow for the maximum load exerted of worker.
- (c) To propose and produce a new design of wheelbarrow base on ergonomic design and QFD to improve and minimize work load.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

To make a new design engineer must understand the customer requirement that is important to expend in market today. It can be relate this information with ergonomic and apply in Quality Function Deployment (QFD). There are many type of material handling and various devices they used to carry the material and manage their work.

Wickens. C. D, (2004) stated the situation when things go wrong that triggers to call for diagnosis and solution, and understanding these situations represent the key contribution of human factors to system design. They may define the goal of human factors as making the human interactions with systems one that.

- a) Enhance performance
- b) Increases safety
- c) Increases user satisfaction

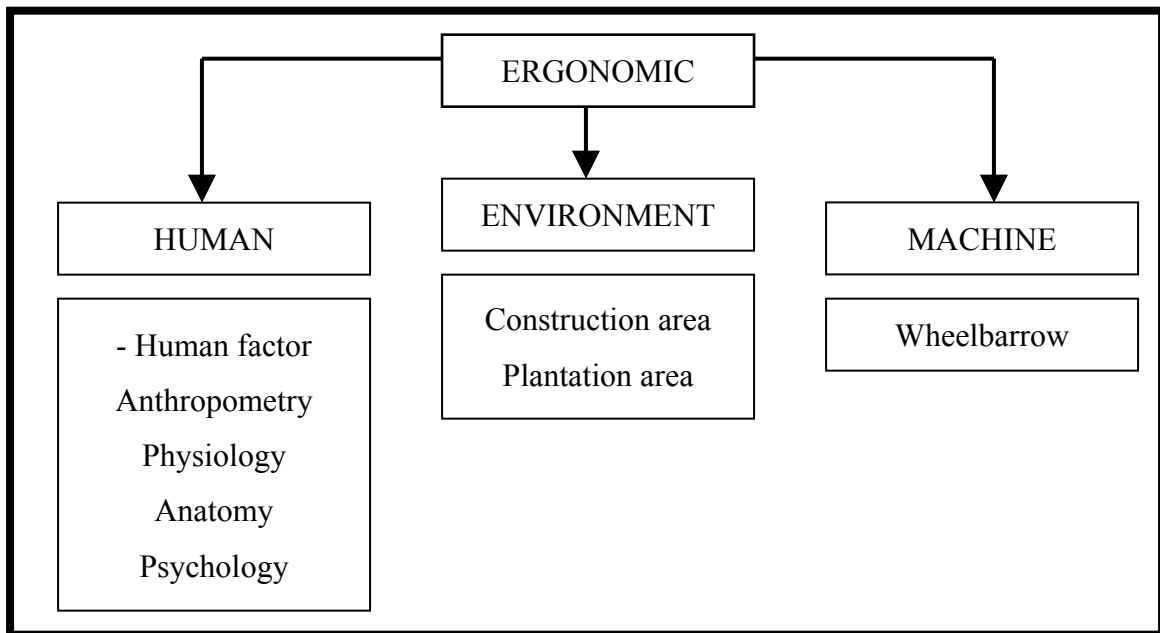
#### **2.2 Definition of Ergonomics**

There are many definition of what the meaning of ergonomic. According to Kroemer, K *et al.*, (2000), ergonomic is the application of scientific principles method, and data drawn from a variety of discipline to the development of engineering system in which

people play a significant role. Among the basic discipline is psychology, cognitive science, physiology, biomechanics, applied physical anthropometry, and industrial systems engineering. The engineering system to be developed range from the use of a simple tool by a consumer to a multiperson is a sociotechnical system.

Ergonomic is the study of the interaction between people and machines and the factors that affect the interaction. Its purpose is to improve the performance of systems by improving human machine interaction. This can be done by designing in a better interface or by ‘designing- out’ factors in the work environment, in the task or in the organization of work that degrade human- machine performance (R.S. Bridger, 2003).

Figure 2.1 show the relationship between Human, Machine and Environment. Assume that the population Korean as similar to the Malaysian as Asian population and choose construction area for the case study to redesign the wheelbarrow.



**Figure 2.1: The Relationship of Ergonomic (Hamzah, N.F, 2007)**

There are three major reasons for applying ergonomics (Kroemer. K, *et. al.*, 2001):

- a) Moral Imperative
  - i. To improve the human condition and quality of life, especially at work and is regard to health, safety, comfort, outcome and enjoyment
  - ii. Certainly, work must be safe, healthy and should be comfortable. It can and should be enjoyable to achieve results at work and through work that we value personally.
- b) Progress in Knowledge and Technology
  - i. To join the human quest to learn more about people and their desires, capabilities, and limitations and to develop and apply new theories
- c) Economic Advantages
  - i. To reduce the effort and cost expended in work systems that include humans as doers, users, and beneficiaries.
  - ii. In many new designs of things and systems, the “human factor” already has been incorporated during the concept stages.

### **2.3 Human factors**

Areas of interest for human factors practitioners may include the following: workload, fatigue, situational awareness, usability, user interface, learn ability, attention, vigilance, human performance, human reliability, human-computer interaction, control and display design, stress, visualization of data, individual differences, aging, accessibility, safety, shift work, work in extreme environments including virtual environments , human error, and decision making.

The term human-factors engineering is used to designate equally a body of knowledge, a process, and a profession. As a body of knowledge, human-factors engineering is a collection of data and principles about human characteristics, capabilities, and limitations in relation to machines, jobs, and environments. As a process, it refers to the