



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**Development of Materials Handling Techniques  
for Occupational Health Improvement of  
Workers in Manufacturing Industry**

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

By

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**UNIVERSITI TEKNIKAL MALAYSIA MELAKA (UTeM)**
**BORANG PENGESAHAN STATUS TESIS\***

JUDUL: DEVELOPMENT OF MATERIALS HANDLING TECHNIQUES FOR OCCUPATIONAL HEALTH IMPROVEMENT OF WORKERS IN MANUFACTURING INDUSTRY

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## **ABSTRACT**

This paper presented development of materials handling techniques for occupational health improvement of workers in manufacturing industry. Malaysia, one of among rapidly industrializing country in Asia region face challenges that influence their competitiveness in term of occupational health. Occupational health is believed to be one of contributor to the success of manufacturing industry. However, lack of attention on occupational health awareness may expose the workers to occupational risk factors. At the same time, manual materials handling activity have placed a burden on workers to reach safe working practices. The project is conducted in a manufacturing industry in Malaysia. The objectives of the project is to develop technique of materials handling in enhance occupational health of workers. The focus of the project is given on manual materials handling because it contributes significantly to occupational diseases. The results represent identification of occupational risk factors caused by manual materials handling activity in the plant. Ergonomics participatory approach used to propose a method of materials handling for safe working condition. Two assessments conducted to generate the result of developing materials handling technique. Developing suitable means by designing two alternatives facilities is done using CATIA Software followed by evaluation the effectiveness of proposed design for safe working practices is done in the last phase. From the evaluation, it can be concluded that; the proposed design is capable to improve occupational health of workers in manufacturing industry.

## **ABSTRAK**

Tesis ini menyampaikan pembangunan teknik pengendalian bahan untuk peningkatan kesihatan pekerja-pekerja dalam industri pembuatan. Malaysia, satu daripada negara pesat membangun dalam sektor industri di rantau Asia menghadapi cabaran yang mempengaruhi persaingan dalam konteks kesihatan pekerjaan. Kesihatan pekerjaan dikenalpasti salah satu penyumbang utama untuk kejayaan industri pembuatan. Bagaimanapun, ketiadaan atau kurangnya kesedaran terhadap kesihatan pekerjaan mungkin mendedahkan pekerja-pekerja kepada faktor-faktor risiko pekerjaan. Dalam pada itu, pekerja-pekerja yang dibebankan dengan aktiviti pengendalian bahan secara manual adalah terdedah kepada amalan-amalan kerja kurang selamat. Projek ini dikendalikan di sebuah industri pembuatan di Malaysia. Objektif projek ini adalah untuk membangunkan teknik bahan-bahan mengendalikan dalam meningkatkan kesihatan pekerjaan pekerja-pekerja. Fokus projek diberikan terhadap pengendalian bahan-bahan secara manual kerana ia nyata sekali menyumbang kepada penyakit pekerjaan. Keputusan mengenalpastian faktor-faktor risiko pekerjaan disebabkan aktiviti manual pengendalian bahan dikenalpasti dari industri tersebut. Pendekatan penyertaan ergonomik digunakan mencadangkan satu kaedah pengendalian bahan yang selamat. Dua kajian dijalankan untuk membangunkan hasil kaedah pengendalian bahan. Membangunkan cara sesuai dengan merekabentuk dua alternatif kemudahan adalah dibuat menggunakan perisian CATIA diikuti penilaian keberkesanan cadangan rekabentuk untuk amalan kerja selamat dilakukan pada fasa yang terakhir. Daripada penilaian tersebut, ianya boleh disimpulkan bahawa; rekabentuk yang dicadangkan adalah mampu untuk meningkatkan kesihatan pekerjaan pekerja-pekerja dalam industri pembuatan.

## **DEDICATION**

*For my beloved Father and Mother who always encourage and give me all the support  
that I really need during accomplish this thesis.*

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# TABLE OF CONTENT

Abstract	i
Dedication	iii
Acknowledgement	iv
Table of Contents	v
List of Figures	viii
List of Table	x
List of Abbreviations, Symbols, and Specialized Nomenclature	xi
<b>1. INTRODUCTION</b>	<b>1</b>
1.1 Background and Problem	1
1.2 Project Requirements	4
1.3 Project Scope and Limitation	5
1.4 Potential Benefits from the Project	6
1.5 Project Outline	7
<b>2. LITERATURE REVIEW</b>	<b>9</b>
2.1 Ergonomics Participatory and Its Applications	9
2.2 The Impact of Occupational Diseases in Manufacturing Industry	11
2.3 The Opportunities of Applying Ergonomics Participatory To Enhance Occupational Health in Manufacturing Industry	14
2.4 Ergonomics Participatory Tools for Occupational Health Assessment	15
<b>3. METHODOLOGY</b>	<b>20</b>
3.1 Case Study	20
3.2 Phase 1: Determination the Current Techniques of Materials Handling	21
3.3 Phase 2: Identification the Occupational Risk Factors	22
3.4 Phase 3: To Propose a Method of Materials Handling For Safe Working	

Condition	25
3.5 Phase 4: The Effectiveness of Proposed Design Practices	27
3.6 Summary of Project Methodology	29
<b>4. RESULT</b>	<b>30</b>
4.1 Condition of Current Materials Handling Technique	30
4.2 Identification of Occupational Risk Factors in Current Materials Handling Technique	32
4.3 Assessment of Problem by Using Ergonomics Assessment Tools to Determine the Effect of Occupational Risk Factors on Workers Health	34
4.3.1 First Assessment: Assessment of Workers Physiology in Current Materials Handling Technique	35
4.3.1.1 Result of Bending Posture Analysis	39
4.3.1.2 Result of Carrying Task Analysis	42
4.3.1.3 Carry Analysis	46
4.4 Improvements on Materials Handling Technique	48
4.4.1 Proposed Design 1	48
4.4.2 Proposed Design 2	50
4.5 Second Assessment: Ergonomics Simulation on Improved Materials Handling Technique	53
4.5.1 Simulation for Proposed Design 1: Lift Table	53
4.5.2 Simulation for Proposed Design 2: Pallet Truck	58
4.6 The Effectiveness of Proposed Design Practices	62
<b>5. DISCUSSION</b>	<b>63</b>
5.1 Condition of Current Materials Handling Technique	63
5.2 Identification of Occupational Risk Factors in Current Materials Handling Technique	64
5.3 Assessment of Problem by Using Ergonomics Assessment Tools to Determine the Effect of Occupational Risk Factors on Workers Health	65

5.3.1 First Assessment: Assessment of Workers Physiology in Current Materials Handling Technique	65
5.3.2 Second Assessment: Ergonomics Simulation on Improved Materials Handling Technique	67
5.4 The Evaluation of Effectiveness Improved Proposed Design Practices	68
<b>6. CONCLUSIONS</b>	69
6.1 Determination the Current Techniques of Materials Handing	69
6.2 Identification the Occupational Risk Factors	70
6.3 Propose a Method of Materials Handling For Safe Working Condition	71
6.4 The Effectiveness of Proposed Design Practices	72
<b>REFERENCES</b>	73
<b>APPENDICES</b>	76
A RULA Posture for Group A and Group B	76
B ISA Risk Factors Reporting Form for the Observation (Worker 2)	77
C First Assessment: Assessment of Worker 2 in Current Materials Handling Technique	78
D Example Product of Manufacturing Industry Specialized in Metal Based Product	81
E Drawing Parts for Proposed Design 1	83
F Drawing Parts for Proposed Design 2	84
G Container Design and Box Design	87

## LIST OF FIGURES

3.1	A Blank Form of ISA Risk Factors Reporting Form	24
3.2	Application of Automated Cranes to Transfer Die to the Platform	26
3.3	Application of Conveyor System to Convey Parts to a Workplace	26
3.4	The Summarization of Project Methodology	29
4.1a	Worker Bends His Body to Reach Materials	28
4.1b	Worker Carry Materials to Tumbling Area	28
4.1c	Worker Bends His Body to Put the Materials Down	29
4.2	ISA Risk Factors Reporting Form for the Observation (Worker 1)	30
4.3	Anthropometry Data of Workers Transferred into CATIA Software	36
4.4	Data Collection Using CAD Software to Measure Trunk Angle	37
4.5	Simulation of Bending Posture	39
4.6	Result of RULA Analysis (right side) for Bending Posture	40
4.7	Result of RULA Analysis (left side) for Bending Posture	41
4.8	Simulation of Carrying Task	42
4.9	Result of RULA Analysis (right side) for Carrying Task	43
4.10	Result of RULA Analysis (left side) for Carrying Task	44
4.11	Result of Carry Analysis for Worker 1	46
4.12	Result of Carry Analysis for Worker 2	47
4.13	Proposed Design 1: Lift Table in Lowering Position	49
4.14	Proposed Design 1: Lift Table in Lifting Position	50
4.15	Proposed Design 2: Pallet Truck in Lifting Position	51
4.16	Proposed Design 2: Pallet Truck in Lowering Position	52
4.17	Result of Simulation for Proposed Design 1a	54
4.18	Result of Simulation for Proposed Design 1b	55
4.19	Result of RULA Analysis (right side) Using Proposed Design 1	56
4.20	Result of RULA Analysis (left side) Using Proposed Design 1	57

4.21	Result of Simulation for Proposed Design 2a	58
4.22	Result of Simulation for Proposed Design 2b	59
4.23	Result of RULA Analysis (right side) Using Proposed Design 2	60
4.24	Result of RULA Analysis (left side) Using Proposed Design 2	61

## **LIST OF TABLES**

2.1	The Description of REBA Action Level	17
2.2	The Description of RULA Score	18
4.1	Anthropometry Data for the Subjects	35
4.2	Input Data for RULA	38
4.3	Results of RULA (first assessment)	45
4.4	Results of RULA (second assessment)	62

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

Kg	-	Kilogram
LI	-	Lifting Index
TNB	-	Tenaga Nasional Berhad
NIOSH	-	National Institute of Occupational Safety and Health
RWL	-	Recommended Weight Limit
UK	-	United Kingdom
US	-	United States
BLS	-	Bureau of Labor Statistics
MSD	-	Musculoskeletal Disorders
CAD	-	Computer Aided Design
CAM	-	Computer Aided Manufacturing
RULA	-	Rapid Upper Limb Assessment
REBA	-	Rapid Entire Body Assessment
N	-	Newton
g	-	Gram
mm	-	Millimeter
min	-	Minute
s	-	Second
WRULDs	-	Work-Related Upper Limb Disorders

# **CHAPTER 1**

## **INTRODUCTION**

Chapter one tries to provide comprehensive background about the project. The focus given to manufacturing industries in Malaysia and discover about the project topic. Descriptive information is given on background and problems, project requirements, project scope and limitation, potential benefits from the project and project outline.

### **1.1 Background and Problem**

Malaysia is one of a country in Asia region with the population of 26.64 million and one of among rapidly industrializing country, with the vision to achieve developed country status by the year 2020. Fast-growth development in several sectors includes agriculture, forestry, mining, quarrying, manufacturing, construction, trading, transportation, services, financial institution and insurance, electricity, gas, water and sanitary services (Danavaindran, 2005). Manufacturing industry sector is one of industrializing parties that gives significant contribution in achieving the vision. Positive developments have occurred in all spheres of manufacturing industry since 1990s (Rampal and Nizam, 2005). Manufacturing industry involved mainly in several industries such as manufacture of food and beverage, wood including furniture, chemicals, petroleum refineries, rubber, plastic, glass, textile and leather, metalworking and non-metallic industries, machinery and equipment industry, and other manufacturing industries sector (Rampal and Nizam, 2005). According to the statistics released by Department of Statistics Malaysia (2006), the positive growth of 9.5% in the manufacturing sector for July, 2006 as compared with the index a year ago was a result of the rise in the indices of 49 out of



a total of 86 industries (57.0%). In addition, the manufacturing sector continued its notable performance in second quarter of 2006 by increasing 8.4% growth. The sales value of the manufacturing sector in July, 2006 expanded by 17.3% or RM6.8 billion to RM46.0 billion as compared to RM39.2 billion registered in July, 2005. This sector also posted an increase in sales value of 7.9% or RM3.4 billion as against RM42.7 billion reported in the previous month.

The number of employees engaged in the manufacturing sector in July, 2006 rose 7.7% or 76,609 persons to 1,067,820 persons as compared to the corresponding month in 2005. As the raising of the number of employees, transforming Malaysia into a developed country by the year of 2020 by rapid industrializing has led Malaysian workforce to face challenges that influence their competitiveness. Normally, this is happen because they are having their limitation especially in term of financial stability or may be caused by lack of understanding about the importance of occupational health issues by the management of companies. If occupational health issues are not being managed efficiently, it will give an impact to the manufacturing industry. One of the major impacts is in term of materials handling. This has required the workers to handle the materials properly to avoid health problem besides keeps the materials in a good condition. However, this unsuitable practice may lead the workers to occupational problems or occupational diseases that may affect their health. The most common occupational diseases associated with poor manual handling techniques are all musculoskeletal in nature and muscular sprains and strains normally occur in the back or in the arms and wrists, back injuries include injuries to the discs situated between the spinal vertebrae, trapped nerve, hernia, fractures, work-related upper limb disorders (WRULDs), rheumatism, cuts, bruising and abrasions (Hughes and Ferrett, 2005). Back injury due to the lifting of heavy loads is very common and several million working days are lost each year as a result of such injuries (Hughes and Ferrett, 2005). In addition to reduce the problem, management has provided material handling facilities such as carts, trucks, wheelbarrows and others. Recent studies reported that these facilities have caused suffering and injuries to workers in various industries because the misuse of such facilities or use of poorly designed vehicles increased the risk of musculoskeletal

problems (Jung, 2005). However subsequent intervention targeted specifically at increasing awareness and understanding amongst key was deemed to have been more successful (Barret, 2005).

There are several approaches that can be applied in reduce occupational diseases in workplace. Some of the approaches include engineering redesigns, work method improvement, administrative controls and ergonomics participatory (Halim, 2006). These approaches may help in reducing and eliminating exposure to occupational risk factors so that it will help avoiding psychosocial stress in working environment. One of useful approach is ergonomics participatory that enhances the occupational health by improving working condition using ergonomics knowledge such as assessing and analyzing working postures of worker, improvement of workstation design and adopting suitable equipments for materials handling technique (Halim, 2006). An ergonomics approach is generally required to design and develop the manual handling operations as a whole (Hughes and Ferrett, 2005). Ergonomics participatory plays an important role in improving workers occupational health. Ergonomics recommendation is believed to eliminate or reduce the occurrence of occupational diseases in workplace. Ergonomics practice continues to be a largely problem solving function (Dempsey, 2005). Back pain and musculoskeletal disorder suffered by the workers are remarkably common condition because a large number of workers experiencing the symptoms every year. However, only a small percentage of people report back pain to a physician, or lost time from work due to back pain in a given year (Brooker, 1997). By applying ergonomics in manufacturing industry, risk factors can be reduced or eliminated based on the solution that will be proposed to improve existing materials handling technique at the workstation. Besides, ergonomics participatory is also capable of enhancing productivity and improve working condition (Kogi, 2003). Improvement on workstation design using suitable material handling facilities (Halim, 2005) has proved the potential materials handling technique to improve occupational health. The new proposed design solution of materials handling technique is believed have a great potential to improve occupational health.

## 1.2 Project Objectives

Manual materials handling require the workers to handle the materials properly to avoid health problem besides keeps the materials in a good condition. However, this unsuitable practice may lead the workers to occupational problems or occupational diseases that may affect their health.

Applying ergonomics participatory is important and necessary in promoting and providing more safe working condition to workers in manufacturing industry. Hence, workers can view and understand each job, which in turn creates a better work process through a more knowledgeable work force. Participation is perceived by the employee as improving his or her quality of work life (Giustina, 1989).

Specifically, the conducted project applied the opportunity of using ergonomics participatory approach in order to achieve the following objectives:

- a) To determine the current techniques of materials handling practiced by the workers in manufacturing industry.

There are several techniques of materials handling that have been practiced in manufacturing industry including conventional and advance techniques such as the use of pallet truck, push cart, robot and others. Current materials handling technique is obtained by walk through and monitor the manufacturing activities in the plant.

- b) To identify the occupational risk factors experienced by the workers while they handling the materials.

The physiological factors of workers such as working postures are assessed and analyzed using ergonomics assessment tools to determine the effect of identified occupational risk factors on workers health. Examples of such activities include rapid or repetitive motion, forceful exertion, excessive mechanical force concentration or lifting of heavy materials, awkward postures and vibration where particular risk factors are present. The

occupational risk factors are studied to find the effective solution that could eliminate them.

- c) To propose an effective solution for materials handling technique in manufacturing industry.

Appropriate equipments are introduced to improve current materials handling technique. Elimination to occupational risk factors is required to promote safe working condition to the workers.

### **1.3 Project Scope and Limitation**

This section is intended to describe the scope and limitations of carried out project. The project specifically focuses on occupational health of workers in manufacturing industry. A case study was conducted in a metal stamping company categorized in Small and Medium Industry (SMIs). In the company, workers who perform materials handling manually were analyzed using ergonomics assessment tools. The selected workers who have been invited to participate in the case study have excellent physical health, active and do not experience any occupational diseases. Majority of workers in the company are male, so gender factor is not considered as significant parameter in the project.

The project discovered the occupational risk factors associated with manual materials handling in workplace using ergonomics approach. The physiology of worker such as working postures, lifting limitation and permissible load capacity were measured to determine the impact of materials handling techniques to the workers health. The physical quantities such as load handled by the workers were also taken into account.

The solution for the improvement of materials handling technique is proposed to the company. Nevertheless, the implementation of proposed solution is depended

on company's willingness to deploy the solution. In addition, the company is free to make decision whether accepts the proposed solutions.

#### **1.4 Potential Benefits from the Project**

The project has no direct access and authority to enforce the proposed solution to the company even though the potential benefit is proved. Although benefits of the project may be difficult to measure, but there are certain points that manufacturing industry will gravitate to when considering specific benefits of participatory ergonomics that are:

- 1) More workers can view and understand each job, which in turn creates a better work process through a more knowledgeable work force. This will increased organizational health, resulting in decreased absenteeism, less turnover, enhanced employee performance, shorter and more effective job performance and fewer complaints or grievances.
- 2) Ergonomics is an excellent communications platform. In a participative process, ergonomics provides more and improved to all levels, functions and organizations.
- 3) There are more satisfied, committed and motivated workers who accept responsibility and ownership of their work and workplace. Participation is perceived by the workers as improving his or her quality of work life.
- 4) A better understanding of injuries and illness parameters by workers results in decreased injury and illness incidents associated with work situations. This can result in reduced workers' compensation costs, as well as health care costs and hidden costs associated with these incidents.

## 1.5 Project Outline

This section is intended to describe four-stage of the project approach which can be summarized as follows:

- a) To identify problem regarding to manual materials handling (stage one).  
There are many ergonomics assessment tools that have been developed for identify and analysis of tasks and equipment regarding to manual materials handling. These approaches include questionnaires, direct observation techniques and direct measurement techniques. However the project will only covering questionnaires and direct observation techniques at manufacturing industry in Malaysian Small and Medium Industries (SMIs) which specialized in metal stamping. The method is by making an interview about questionnaire that have been prepared earlier, capture some picture and videotaping. Basically, a direct observation is performed by walkthrough inspection at the workstation areas.
  
- b) Assessing and analyzing problem by using ergonomics assessment tools to determine the effect of occupational risk factors on workers health (stage two).  
Working posture related to the use of human body can be analyzed using several ergonomics assessment tools such as Rapid Upper Limb Assessment (RULA) (McAttamney and Corlett, 1993), and NIOSH Lifting Equation (Waters, 1993). The result obtained from the problem regarding to manual materials handling is assessed and analyzed using one of the tools. CATIA Software simulation is used to analyze the impact of current materials handling technique to occupational health of the workers.
  
- c) To propose solution based on the result (stage three).  
This stage requires redesigning of existing materials handling technique and selection of suitable means to encounter the occupational risk factors. Designing proper materials handling technique can be achieved by using

design software such as AutoCAD, Solidworks and CATIA. Appropriate materials handling equipments are introduced during this stage so that the occupational risk factors contributed by manual handling can be eliminated.

d) The effectiveness of proposed design practices (stage four).

The software simulation is used to analyze the impact of using new proposed design solution of materials handling technique to improve materials handling technique. The simulation will demonstrate the effectiveness of proposed solutions before ergonomics intervention and after design simulation.

## **CHAPTER 2**

### **LITERATURE REVIEW**

This chapter proceeds with a fully-referenced review from the relevant literature. This chapter highlights past studies related to the subject of this project. It contains a literature review on the importance of occupational health in industry and a survey of attempts that have been made to improve occupational health. Source of information were obtained from journals, handbooks, reports and electronics media publications. The main objective is to determine the effectiveness of ergonomics participatory approach in improving occupational health. Each issues raised is critically examined based on information collected from cited literature.

#### **2.1 Ergonomics Participatory and Its Applications**

Ergonomics is one of common tools that have been used to improve occupational health, safety and environment in industry. Ergonomics focuses on the role of humans in complex systems, the design of equipment and facilities for human use and the development of environmental comfort and safety. The term ergonomics has several definitions. Ergonomics is the science on how to fit the task and working environment to the workers. Wilson (1991) gives his early definition about ergonomics as involvement of workers and managements in making decisions about their tasks, systems, workplaces and organizations. While Nagamichi (1995) give his definition about ergonomics participatory as a technique by which workers and management shared their resources together to impact ergonomics knowledge and implement procedures in the workplace in order to improve occupational health and productivity. He added that ergonomics participatory began by organizing a project