



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**EVALUATION OF RISK FACTOR IN MANUAL LOAD
CARRYING**

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

by

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DECLARATION

I hereby, declared this report entitled “Evaluating Risk Factors in Manual Load Carrying” is the results of my own research except as cited in references.

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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 Management) with Hons. The member of the supervisory committee is as follow

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(Nor Akramin Bin Mohamad)

ABSTRAK

Pengendalian bahan secara manual adalah aktiviti yang melibatkan jumlah beban yang dilaksanakan oleh manusia, contohnya, mengangkat, menurunkan, menolak dan menarik. Kaedah- kaedah seperti salah pemindahan dan kedudukan, serta, kesedaran di tempat kerja adalah di tahap rendah terutamanya dalam sektor pembuatan. Ini boleh menyumbang kepada pendedahan faktor-faktor risiko dan menyebabkan pekerja mengalami penyakit yang digelar sebagai *Musculoskeletal Disorders (MSDS)*. Tiga objektif yang telah di rangka di dalam kajian ini, iaitu untuk mengkaji faktor risiko yang menyumbang kepada ketidakselesaan otot semasa melaksanakan pengendalian bahan secara manual, untuk menganalisis hubungan antara *Rapid Upper Limb Assessment (RULA)* dan *Revised NIOSH Lifting Equation* bagi menentukan saranan had berat dan akhir sekali untuk menentukan kesan antropometri dengan berbeza ketinggian meja. Maklumat yang berkaitan telah dikumpulkan melalui satu set soal selidik dan beberapa faktor risiko telah dikenalpasti. Hubungan ketara diantara RULA analisis dan *Recommended Weight Limit (RWL)* telah dikenalpasti dan ketinggian meja yang terbaik adalah 65 cm hingga 80 cm. Antropometri akan memberi kesan kepada setiap ketinggian meja kerana kewujudan postur janggal yang dikenal pasti melalui analisis RULA. Pemilihan ketinggian meja yang terbaik diambil berdasarkan hasil sebelumnya dengan menjadikan ketinggian manusia sebagai pembolehubah. Kesimpulannya, ketinggian meja 75 cm dan 80 cm, telah dikenalpasti sebagai yang paling sesuai untuk ketinggian manusia iaitu 155 cm hingga 180 cm.

ABSTRACT

Manual Material Handling (MMH) is an activity which involves a significant amount of load perform by human such as lifting, loading, pushing and pulling. Improper ways of handling this activity such as wrong transfer method and position together with low level of awareness of MMH in workplace, especially in manufacturing sector can contribute to an exposure of risk factors, resulting workers to suffer from a disease called Musculoskeletal Disorders (MSDs). There are three objectives of this research, which are to study the risk factor contributing to the muscle discomfort during performing manual load carrying, to analyze the relationship between Rapid Upper Limb Assessment (RULA) with Revised NIOSH Lifting Equation and lastly to determine the effects of anthropometry with different range of table height. Related information were gathered through a set of questionnaire and certain risk factor had been identified. A significant relationship between Recommended Weight Limit and RULA analysis was determined and as a result, the best range of table height was from 65 cm to 80 cm. Anthropometry will effect certain table height due to awkward posture identified through RULA analysis. The choice for best table height based on previous result, was narrowed down by implementing the man height as the variable. In the end, the best table range of 75 cm to 80 cm were identified as the most suitable for man height of 155 cm to 180 cm since it can fit wider range of human height.

DEDICATION

My beloved parents, Mr. Mohd Sani Bin Abbas and Mrs. Zainon Bt Hassan

Beloved Siblings

Motivated Supervisor

Respectful Panels

Awesome Friends

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURES

3DSSPP	-	3D Static Strength Prediction Program
AL	-	Action Limit
AM	-	Asymmetry Multiplier
ANOVA	-	Analysis of Variance
BMI	-	Body Mass Index
CATIA	-	Computer Aided Three-Dimensional Interactive Application
CM	-	Coupling Multiplier
DM	-	Distance Multiplier
ERF	-	Ergonomic Risk Factor
FM	-	Frequency Multiplier
G	-	Group
LBP	-	Low Back Pain
LC	-	Load Constant
MAW	-	Maximum Acceptable Weight
MMH	-	Manual Material Handling
MSDs	-	Musculoskeletal Disorders
NIOSH	-	National Institute for Occupational Safety and Health
OSH	-	Occupational Safety and Health
RULA	-	Rapid Upper Limb Assessment
RWL	-	Recommended Weight Limit
SOCISO	-	Social Security Organization
SEMG	-	Surface Electromyography
VM	-	Vertical Multiplier
WMSDs	-	Work-related Musculoskeletal Disorders

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Manual material handling (MMH) are the most common task perform by human in working sector, especially in the manufacturing sector, such as food processing and plastic production. In Malaysia, the statistics of monthly manufacturing reported that there are approximately 2.22 million people working in the manufacturing industry (Sazarina et al., 2012). Even though there is an increasing demand for the usage of automation robots in most workplaces, a large proportion of industrial activities are still demanding the jobs to be remain handled manually. While, Deros et al., (2015) agreed that manual work resource or the term used as MMH activities is still dominant in most manufacturing industry. According to Chung and Kee (2000), it is estimated that more tasks are manually performed in Korea, where labor-intensive industries are more prevalent and industrial processes are less automated. MMH actually requires a person to perform an activity which involve a significant amount of load. However, MMH also has been considered as a major occupational hazard to workers. One of the various task of MMH which is load-lifting is thought to be the source of Musculoskeletal Disorders (MSDs) especially low back problems.

Matsui et al., (1997) found that physical job demands show a clear association with the point and lifetime prevalence of low back pain (LBP). The incidence, severity, and potential disability of low back pain are all related to the demands on the individual in the workplace.

Health and Safety Review (2010) state that a study of civil court judgments on cases concerning injury due to manual handling had identified the key factors which include:

- i. Lack of safe system of work plans.
- ii. Mechanical aids were not provided and maintained.
- iii. No risk assessment of work activities and no evidence of work supervision.

1.2 Problem Statement

Health and Safety Review (2010) stated that, musculoskeletal injuries at work are one of the major drain on the resources of an employer, which includes increasing in cost such as sick pay, lost productivity, legal fees and injury benefit. In fact, injuries due to manual handling are reported to be 33% of all accidents each year, and nearly 20% take place in the manufacturing sector. This type of the problem does not terminate in a developed country like the United States, but it is also quite prevalent in Malaysia as well (Mohamed and Ideris, 2012). According to Sazarina et al., (2012), they claimed that due to further development in industry, Malaysia are not exempted to face the issue of work-related musculoskeletal disorder (WMSDs) arise from MMH activity. Figure 1.1 shows the accident statistics reported by Social Security Organization (SOCSO) in Malaysia whereby the number of accidents related to musculoskeletal diseases increased from 10 cases in 2005 to 675 in 2014 (SOCSO, 2014).

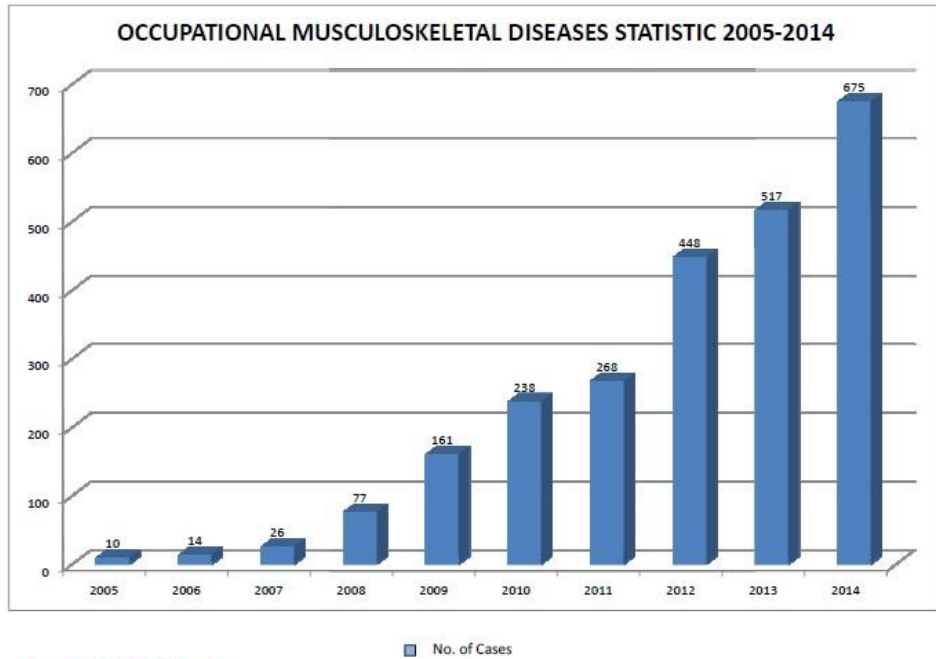


Figure 1.1: Accidents Statistics Related to Musculoskeletal Diseases (SOCSO, 2014).

Inappropriate ways of performing MMH activities including repetitive lifting heavy loads, wrong transfer method and position may result a person suffering from a Work-related Musculoskeletal Disorders. WMSDs are injuries of the soft tissues muscles, tendons, ligaments, joints, and cartilage and nervous system. They can affect nearly all tissues, including the nerves and tendon sheaths, and most frequently involve the arms and back (Jaffar et al., 2011). While Nimbarte (2014) states that, WMSDs are the non-traumatic soft tissue disorders that are caused or exacerbated by workplace exertions. Studies show that MSD in the workplace are a common notion which the work itself is the root cause of the MSD (Wind et al., 2005). In fact, MSD is a leading cause in manual handling injuries that gives a major burden to the employee, society, and organizations.

According to the year 2007 in-house report of an automotive manufacturing company in Malaysia, the total number of workers suffering from back pain had increased from the year 2005 until 2006. A total of 954 cases of back pain and 783 workers had been involved with this illness were reported by the in-house clinic throughout the year (Baba et al., 2010). Low back pain may be acute or chronic. Acute low back pain can be treated within a short time of period, compared to chronic low back pain that take long time to recover (Pengel et al., 2003). Marras et al., (2007) states that three general risk factor categories for LBP have been identified in Table 1.1.

- i. Personal (associated with the individual predisposing them to the condition).
- ii. Psychosocial (associated with organizational work practiced).
- iii. Occupational (associated with the work task).

Table 1.1: Potential risk factors for Low Back Pain (Marras et al., 2007)

Classification	Risk Factors
Personal	Age, gender, Body Mass Index (BMI), family history, smoking, and alcohol.
Psychosocial	Job demands, job stress, social relations, and decisions.
Occupational	Force, lifting, posture, bending, twisting, repetition and vibration.

However, most data concerning back pain are related to developed countries and information about back pain in developing and low-income countries are lacking (Ghaffari et al., 2006). In Malaysia, the awareness of injuries such as back pain is still at the low level compared to other develop countries and it is still being promoted by the Occupational Safety and Health (OSH) practitioners to enhance the awareness level of all Malaysians (Deros et al., 2009). Earlier, Durishah et al., (2004) found that

ergonomic staff in workplace are still low level of awareness of safety and health. The manufacturing sector involves different types of production from semiconductors, plastics, automotive and others. The task conducted frequently required human to perform manually, such as lifting a heavy load in the workstation. However, not all MMH tasks are hazardous, and if it is implemented correctly, the chance to expose for injury are low. Noriah (2010) claimed that, company should take responsibility to provide safety and health requirements, either by giving out information, organize an exhibition or seminar to the workers. Therefore, it is very important for workers to be aware of potential workplace hazard so that workers can develop better ways of performing MMH tasks.

1.3 Objectives

- i. To study the risk factor contributing to musculoskeletal injuries during performing manual load carrying by using ergonomics assessment tools.
- ii. To analyze the relationship between Rapid Upper Limb Assessment (RULA) and Revised NIOSH Lifting Equation.
- iii. To evaluate the effects on anthropometry with different range of table height.

1.4 Scope

The focus of this research is identifying the risk factor for a lifting task only. There are two study areas involve in this research. First, in the industry for distribution of questionnaire among 30 respondents. The gender includes female and male with various age group. The second area is in Universiti Teknikal Malaysia Melaka (UTeM) for experimental purpose. This experiment will be focusing on human posture with table height and anthropometry of human as the parameter. Data is collected through

RULA analysis by using CATIA software together with Revised NIOSH Lifting Equation for calculation of Recommended Weight Limit (RWL).

1.5 Significant of Study

Ergonomic is an interesting topic to discuss for, in fact, there are some potential benefit in terms of sustainability that can be gained throughout this study. As an example, the industry will increase their productivity if all workers' health is sustained. Therefore, this study will help workers in any workplace to be aware of risk factors that can contribute to body discomfort. Management of the company can use the data collected for purchasing any equipment, or designing a better workstation which can lead to a safe and healthy environment. In the future, the statistic of injuries in the industry, especially in Malaysia will be decreased.

1.6 Summary

This research encounters the main topic that covers the overall study, which is manual material handling. The purpose of this research is to investigate what are the possible risk factor that contribute to musculoskeletal injuries occurred when the person is performing MMH task such as lifting. This chapter is presented in the form of background of study, problem statement, objectives and scope and the significance of study.

CHAPTER 2

LITERATURE REVIEW

This chapter is the summary of Manual Material Handling (MMH) topic. Brief discussion and different opinions from previous researchers on this issue is also provided. Other than that, the basic understanding of MMH is also reviewed such as the definition itself. In addition, since this study relates to the risk factor, the literature review goes down narrow to the type of MMH task, and also the effect to the human body while performing MMH. In the end, a risk assessment used to study about the risk of MSD is discussed.

2.1 Manual Material Handling (MMH)

Ergonomics is a field that integrates knowledge gained from the human science. The primary goals of ergonomics is to optimize the ease of the worker as well as providing a safe and healthy surrounding. In fact, it is an essential in occupational health practice that should be taken seriously by any working organization. In the last 40 years, manual material handling task have been one of the most discussed topic in ergonomic, biomechanics and other subject related (Chung and Kee, 2000). In fact, many researchers are interested in this topic and had discussed different opinions related to MMH in their research. All discussions are tabulated in Table 2.1.

Table 2.1: Different Opinions Related to MMH Research.

Journals	Researcher/s	Descriptions
1	Rajesh et al., (2013)	Discussed on ergonomic redesign related to the MMH work system.
2	Rossi et al., (2013)	Discussed in developing and implementing multi-criteria approach for choosing the optimal alternative for MMH.
3	Steele et al., (2014)	Discussed on comparing Liberty Mutual Table with biomechanically derived pushing guidelines for shoulder complexity during MMH task.
4	Pinder and Boocock (2014)	Discussed on how to predict the Maximum Acceptable Weight (MAW) of MMH task which is lifting.
5	Matebu and Dagneu (2014)	Discussed on the MMH working posture of an operator using 3D Static Strength Prediction Program (3DSSPP) software.
6	Ray et al., (2015)	Discussed on survey on occupational risk factors of MMH tasks on a construction site in India.

The usage of MMH also has become wider in most workplaces. In fact, MMH give an advantages, for example, reducing the percentage of having accident when using

automated robots in workplaces so that workers are motivated to finish their task. Uttam, (2013) states that MMH offer benefits for improving productivity and increasing safety if it is implemented properly by the worker. While, Deros et al., (2015) believe that MMH gives an advantage in terms of flexibility of transferring simple and light object when compared to using mechanical aids.

Transferring material should be a non-value added activity in production line since it does not affect the product. In the meantime, most workers in company are lack of knowledge of MMH and they are not mindful of the negative effects of improper MMH handling techniques which leads to an increasing production cost and unsafety environment. Management should lead this issue seriously because the workers might not be able to see the effect since they are used to do the same task every day and their age is still young, however, for long term period, many workers could suffer from MSD disease. Table 2.2 shows the distribution of the workers' perception regarding knowledge of ergonomics and MMH according to previous research data.

Table 2.2: Percentage of Worker's Perception on Ergonomics and MMH Knowledge
(Deros et al., 2015)

Question Items	Yes	No
Ergonomic knowledge	71.9	28.1
Knowing the effects of neglecting ergonomics.	9.4	90.6
Knowing the function of MMH	18.8	81.2
Attended ergonomics seminar	12.5	87.5

2.1.1 Manual Material Handling Task

Uttam (2013) states that, MMH involves manual movement of materials in different position and angle, either in: