UNIVERSITI TEKNIKAL MALAYSIA MELAKA

EVALUATING RISK FACTORS IN MANUAL MATERIAL HANDLING TASKS (LIFTING AND LOWERING)

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 Material Handling Tasks (Lifting and Lowering)" is the results of my own research except as cited in the references

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Date	:	2nd July 2015

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 Honours. The member of the supervisory committee is as follow

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(Nor Akramin Bin Mohamad)

ABSTRAK

Pengendalian bahan secara manual seperti mengangkat, menurunkan, menolak, menarik atau memegang memerlukan kekuatan manusia untuk mengendalikannya. Otot atau kekuatan manusia ialah struktur asas dalam pengendalian bahan secara manual. Pengendalian yang salah boleh menyebabkan berlakunya ketidakselesaan otot pada pekerja. Objektif utama kajian ini ialah untuk mendapatkan maklumat tentang faktor risiko yang menyebabkan lesu otot; untuk menganalisis aktiviti otot semasa pengendalian bahan secara manual menggunakan kaedah Rekabentuk Eksperimen dan membina hubungan model antara aktiviti otot dengan peramal iaitu postur badan, jisim beban dan masa pendedahan. Soal selidik digunakan untuk mengumpul maklumat tentang penilaian faktor risiko yang menyumbang kepada ketidakselesaan otot. Data untuk aktiviti otot di RT bisep BR, LT bisep BR, LT Upper Trap, RT Lumbar ES dan LT Lumbar ES dianalisis dengan menggunakan peralatan *surface Electromyography* (sEMG) semasa subjek melaksanakan pengendalian secara manual dan akhir sekali hubungan antara aktiviti otot dan parameter (postur, jisim beban, masa pendedahan) akan dimodelkan menggunakan analisis varians (ANOVA). Keputusannya, jisim beban menjadi faktor penting yang menyebabkan terjejasnya aktiviti otot semasa eksperimen dan tiada interaksi yang terlibat. Model hubungan pula membuktikan hanya tiga otot (RT Biceps BR, LT Biceps BR dan LT Upper Trap) yang terlibat dalam pembentukan model linear untuk menunjukkan nilai pekali daripada parameter yang boleh menjejaskan aktiviti otot. Kesimpulannya, jisim beban menjadi faktor utama yang menjejaskan aktiviti otot semasa pengendalian manual dalam eksperimen yang boleh menyebabkan lesu otot dan hubungan model membuktikan terdapat tiga otot yang terlibat dalam pembentukkan model iaitu otot RT Biceps BR, LT Biceps BR dan LT Upper Trap.

ABSTRACT

Manual handling activities such as lifting, lowering, pushing, pulling or holding a load are commonly examples of tasks that requiring human strength. Muscle or human strength is a basis for manual material handling (MMH) job and workplace design. Improper ways of manual handling will cause a muscle fatigue and muscle discomfort at the workers. Manual handling activities at work can result in a wide range of musculoskeletal disorders (MSDs). The main objectives of this study were to evaluate risk factors contributing to muscle fatigue; to analyze muscle activity while performing MMH tasks using Design of Experiments methodology and to model relationship between muscle activity with predictor namely body posture, load mass and exposure time. To assess the risk factor contribute to muscle discomfort, related information were gathered from the questionnaire. Data for muscle activity at RT Biceps BR, LT Biceps BR, LT Upper Trap, RT Lumbar ES and LT Lumbar ES were analyzed using surface electromyography (sEMG) while subject performing manual lifting/lowering task and lastly the relationship between muscle activity and parameter (posture, load mass, exposure time) were modelled using analysis of variance (ANOVA). As a results, load mass become an important factor that affected all muscle activity during the experiments and no interaction involved since all the combination were not significant. From the model relationship, only three muscles (RT Biceps BR, LT Biceps BR and LT Upper Trap) were involved in performing linear model as to show the coefficient value from the parameter that can affected muscle activity. As a conclusion, load mass become a main factor that can contribute to muscle fatigue and model relationship proved that there were three muscles involved were formed at RT Biceps BR, LT Biceps BR and LT Upper Trap muscle.

DEDICATION

Dedicated to my beloved parents, Mr. Zaini Bin Ismail and Mrs. Nor Iazan Binti Mohd Ali. Also, to all panels, my family and friends for all the encouragements.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURES

ANOVA	-	Analysis of Variance
APDF	-	Amplitude Probability Distribution Function
BLS	-	Bureau of Labour Statistics
BMI	-	Body Mass Index
DF	-	Degree of Freedom
ES	-	Erector Spinae
EGM	-	Electrogoniometer
EMG	-	Electromyography
HAV	-	Hand Arm Vibration
ILO	-	International Labour Organization
INC	-	Inclinometer
KG	-	Kilogram
LT	-	Left
LBD	-	Low Back Disorder
MS	-	Mean Square
MLTs	-	Material Licensing Tracking System
MMH	-	Manual Material Handling
MSD	-	Musculoskeletal Disorder
NIOSH	-	National Institute of Occupational Safety and Health
OSHA	-	Occupational Safety and Health Act
PLBDR	-	Probability of Low Back Disorder Risk

PSM 1	-	Projek Sarjana Muda 1
PSM 2	-	Projek Sarjana Muda 2
RA	-	Reverse Arrangement
RT	-	Right
RMS	-	Root Mean Square
SS	-	Sums of Square
SEMG	-	Surface Electromyography
TRAP	-	Trapezius
WBV	-	Whole Body Vibration
WHO	-	World Health Organization
WMSD	-	Work-Related Musculoskeletal Disorders

CHAPTER 1
INTRODUCTION

1.1 Introduction

This research centers on problems related to issues on muscle activity while carrying a manual material handling task. Specifically, the purpose of this research is to identify the risk factor, and investigate the muscle activity that affected from the specific manual material handling tasks.

This chapter begins with a background study and then discusses and presents the problem statement, objectives and scope involves. Finally, the organization of the whole research is presented.

1.2 Background of Study

In contempt of the widely use of robots in industrial jobs such as assembling parts and Material Licensing Tracking System (MLTs), there are still several tasks in industry that require humans to perform it manually. These tasks consist of lifting, holding, carrying, or moving loads in the work area. They often cause musculoskeletal injuries to that worker (Jozef Zurada, 2012; Shengli Niu, 2010;). Although the majority of jobs becomes automated, human strength is still used in many industrial activities. Other researchers also agreed that manual material

handling (MMH) tasks such as lifting, lowering, pushing, pulling or carrying loads are common tasks that require human strength (Min K.Chung & San H. Kim, 1996).

There is a risk of injury if such tasks are not carried out properly and safely and researcher shows an important correlation between manual handling and musculoskeletal injury (Widanarko et al, 2011). Manual lifting exists as a significant problem even with more frequently developed industrial activities and technologies that lead to musculoskeletal injury (Kim et al. 2011). Over one third of reported injuries in the UK resulting in 3 days or more absence are cause by manual handling incidents at work (Health Safety Executive, 2010b).

In a bad scenario, the effect of musculoskeletal injuries may result in performance decrement for industrialized countries. World Health Organization came out with the result that musculoskeletal injuries or musculoskeletal disorder (MSDs) are the leading cause of workplace disability in developed countries (WHO, 2003). Representing one-third of work injuries, they have affected some criteria such as:

i. Significant economic and social consequences (Punnett and Wegman, 2004)
ii. High cost for company due to reduced of quality and productivity (Eklund, 1997)
iii. Overburden the health system (Badley et al., 1994)

Until this time, there are only a handful of tools that exist for assessing lifting risk. National Institute of Occupational Safety and Health prepare the health and safety community with a lifting index so it can be used easily in industry or factory floor. However, there is still some limitation to apply this application because data quality needed for kinematic or kinetic model inputs are difficult to obtain. (J.D. Matthews et al. 2007).

1.3 Problem Statement

The Department of Occupational Safety and Health Malaysia stated that there are almost 700 occupational musculoskeletal diseases happen in 2014 and make the number increase from the previous year 2013 (SOCSO Annual Report, 2014). Besides that, in the same period there were a report stated that the fatal injuries occurred for every 3.2 cases out of every 100,000 full-time workers (Bureau of Labor Statistic, 2012). Ergonomics problems at the work area and bad organization of work are among of the reasons that contribute to risk factor as mentioned by occupational safety and health problem (Shengli Niu, 2010). Among situation that contribute to the raising magnitude of musculoskeletal disorders (MSDs) suffered by the workers are caused by postural stress from prolonged standing, sitting, and awkward posture. In addition, the psychosocial factors including psychological stress, job stress and job dissatisfaction are the factor that related to ergonomics problem. Most of the ergonomics problems are related to the risk factor affected to the workers (Frymoyer & Mooney, 1986).

Work related MSDs may occur even the workers are exposed to an occupational risk factor at the workplace on an occasional basis for only 25% or less as stated by previous exposure-response data. (Punnet, 2000). Risk factor can cause several visual effects such as eye strain, fatigue, MSDs such as low back pain, neck pain, shoulder pain, repetitive motion injuries and tensions (Punnett & Wegman, 2004). According to Bureau of Labor Statistic, there are 387, 820 MSD cases accounted for rate of 33% worker injury and illness in 2011. (OSHA 2012).

Previous researcher stated that the number of musculoskeletal accidents during lifting is up to 52%, pushing and pulling 13%, holding loads 10%, repetitive movement is about 13% and 12% is for others manual material handling activities. (Abdillah, 2013).

Figure 1.1 and 1.2 below shows a problem relates to the MSD most common work-related problem and exposure to physical risk. MSD causes 25% of workers complain of backache and 23% of muscular pain. In term of physical risk exposure,

65% report a repetitive hand and arm movement as a problem, 45% of working in painful and tiring position and 35% are required to working with excessive heavy loads (Shengli Niu, 2010).

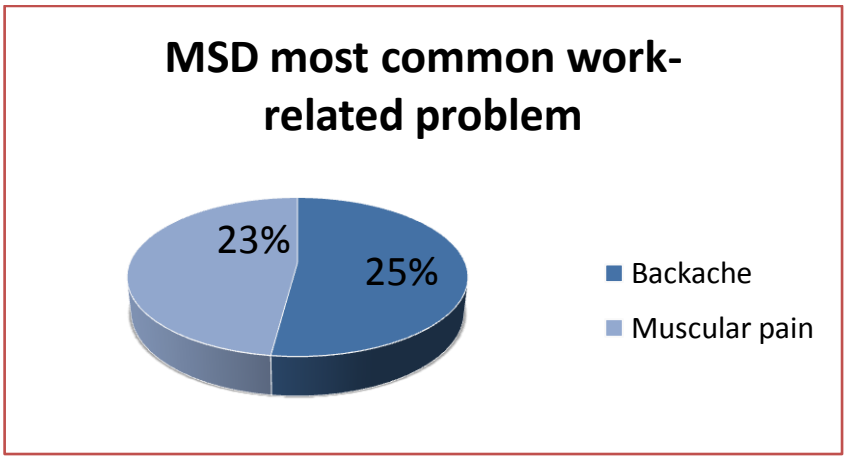

Figure 1.1: MSD Most Common Work-Related Problem

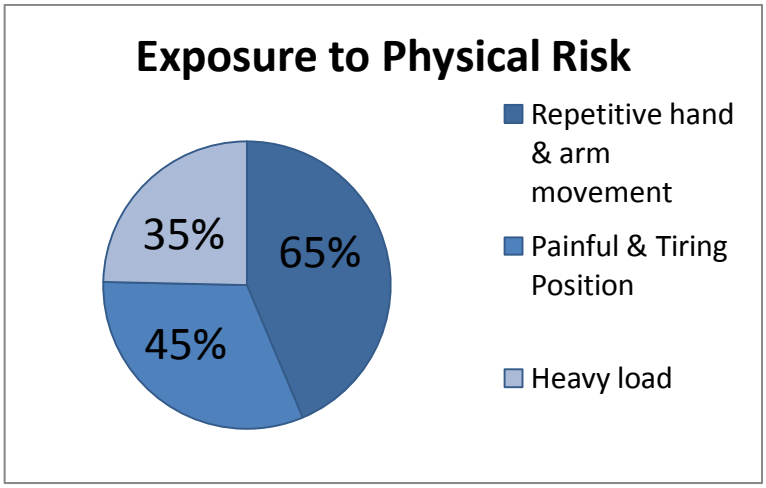

Figure 1.2: Exposure to Physical Risk

1.4 Project Objective

The specific objectives of this study are elaborated as follows:

1. To evaluate the information of risk factor contributing to muscle fatigue and muscle discomfort associated with manual material handling tasks.
   The physiological factors of workers such as working postures are determined and analyzed using ergonomics assessment tools to regulate the effect of identifying occupational risk factors on worker's health. Examples of such activities include working posture, repetitive motion, forceful exertion, contact stress or vibration where the related risk factors are involved.

2. To analyze muscle activities of workers while they are performing manual material handling task by using Design of Experiments (DOE) methodology.
   The purpose of this activity is to analyze and evaluate the muscle activity recorded using surface electromyography (sEMG) and muscle discomfort within specific time of manual material handling task.

3. To model relationship between muscle activities with posture, load mass and exposure time.
   The purpose of this objective to analyze and to identify the factor or factors that affected most muscle activity and to identify which factors that iterated on the effect muscle activity.

1.5 Scope and Limitation of Study

This section is intended to describe the scope and limitations of carried out study. This study will be focusing on the real situation such as human (subject), work load, manual handling tasks, exposure time and rest time. Risk factor that contributed to muscle fatigue and discomfort associated with manual material handling were observed and identified. Muscle activities that are related to the participants will be identified based on the parameter namely body posture, load mass and exposure time from the experiments.

These experiments were focused only on three samples from the same population due to the time constraint and limited electromyography equipment. The analysis of muscle activity will be conducted in real experiment situation. Data from muscle activity will be analyzes using computer software and ANOVA method were used to model the relationship between muscle activity and parameters involved.

1.6 Organization of Report

The whole of the research is arranged in Table 1.1 below. The research included five chapters which consists introduction, literature reviews, methodology, result and discussion and finally the conclusion.