UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Ergonomic Intervention to Reduce the Risk of Musculoskeletal Disorders (MSDs) for Manual Materials Handling Tasks

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

By

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DECLARATION

I hereby, declare this thesis entitled "Ergonomic Intervention to Reduce the Risk of Musculoskeletal Disorders (MSDs) for Manual Materials Handling Tasks" is the result of my own research except as cited in the references.

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ABSTRACT

This project presents the application of ergonomic intervention to reduce the risk of musculoskeletal disorders (MSDs) for manual materials handling tasks. Malaysia is one of the rapidly industrializing country in Asia region but it also faced challenges of the risk of MSDs. This is due to lack of attention on safety awareness in workplace. The major risk factors for MSDs are heavy manual material handling, repetitive tasks and awkward working postures. Since the manual materials handling tasks are contributed to the risk of MSDs, therefore this project was conducted to reduce the risk of musculoskeletal disorders for manual materials handling tasks by using RULA and Revised NIOSH Lifting Equation. The results found that MSDs experienced by the worker are caused by manual materials handling tasks. Then, ergonomics intervention approach was used to propose the materials handling devices and workstation design for safe working condition. Two materials handling devices and two new workstations have been designed by using CATIA software. Lastly, the effectiveness of the proposed design for working posture had been evaluated by using RULA analysis, however lifting limits are assessed by using Revised NIOSH Lifting Equation. From the evaluation, it can be concluded that the proposed design is capable to reduce the risk of MSDs for manual materials handling tasks in manufacturing industry.

ABSTRAK

Tesis ini menyampaikan aplikasi ergonomik untuk mengurangkan risiko musculoskeletal disorders (MSDs) ketika kerja pengendalian barangan secara manual. Malaysia adalah Negara yang membangun dengan pesat di dalam sektor perindustrian tetapi ia masih menghadapi risiko MSDs. Ia adalah kerana pekerja-pekerjanya di kilang-kilang masih tidak menyedari kepentingan keselamatan di tempat kerja. Kecenderungan rikiso yang menyebabkan MSDs ialah kerja pengendalian barangan yang berat secara manual, kerja-kerja yang berulang-ulang dan postur kerja yang tidak sesuai. Oleh itu, kerja pengendalian barangan secara manual telah dikenalpasti menyumpang risiko MSDs. Projek ini telah dikendalikan untuk mengurangkan risiko MSDs bagi kerja pengendalian barangan dengan tangan dengan mengaplikasikan pengendalian ergonomik. Pernilaian telah dikendalikan untuk mengenal pasti risiko MSDs yang telah dialami oleh pekerja yang terlibat dengan pengendalian barangan secara manual. Selain itu, dua alat pengendalian barangan dan dua tempat kerja yang baru telah direkabentuk dengan menggunakan perisian CATIA. Akhirnya, keberkesanan postur (angkat atau letak) pekerja telah dinilai dengan menggunakan RULA, manakala cara pengendalian barangan telah dinilai dengan menggunakan Revised NIOSH Lifting Equation. Hasil penilaian tersebut, ianya boleh disimpulkan bahawa rekabentuk yang telah dicadangkan adalah mampu mengurangkan risiko MSDs untuk kerja pengendalian barangan secara manual di industri pembuatan.

DEDICATION

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

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LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE

SMIs	-	Small and Medium Industries
MSDs	-	Musculoskeletal Disorders
NIOSH	-	National Institute of Occupational Safety and Health
RULA	-	Rapid Upper Limb Assessment
RWL	-	Recommended Weight Limit
LI	-	Lifting Index
REBA	-	Rapid Entire Body Assessment
LBP	-	Low Back Pain
LMM	-	Lumbar Motion Monitor
EMG	-	Electromyography
SNQ	-	Standardized Nordic Questionnaire
STLI	-	Single-Task Lifting Index
MMH	-	Manual Material Handling
Mm	-	Milimeter
Min	-	Minute
S	-	Second
Kg	-	Kilogram

CHAPTER 1

INTRODUCTION

Chapter one describes the overall background of this project. The scope of this project is focused in Malaysian Small and Medium Industries (SMIs). The content of this chapter includes background and problem statement, project objectives, Scope and limitation of project, and potential benefits from the project.

1.1 Background of Study

Ergonomic risk factors are the aspects of a job or task that impose a biomechanical stress on worker. Ergonomic risk factors are the synergistic elements of musculoskeletal disorders (MSDs) hazards. The following ergonomic risk factors are most likely to cause or contribute to the MSDs such as force, vibration, repetition, contact stress, awkward postures, extreme temperatures and static postures. The term musculoskeletal disorders (MSDs) refers to conditions where the worker who had experienced discomforts or injuries of neck, shoulder, lower back, and elbow, hand,hip and knee, as well as multiple joints manifesting ache, tingle, swelling and pains. However, workstation analysis is useful to identify all risk factors present in the workstation. The analysis includes the checking of excessive vibration of tools, tools, working level should be adjusted to worker and working postures and movements in the workstation should be assessed for four levels of risk.

Over the last four decades, ergonomic researches and practitioners have devoted considerable resources to solve the problems associated with manual materials handling (MMH). Almost a broad consensus also agreed that manual lifting is physically the most stressful material handling activity because it is best to contain the manual lifting injury hazard. Results of such efforts are reflected in terms of various guidelines and weight limit recommendations for manual lifting activities.

Musculoskeletal disorders (MSDs) were recognized as having occupational etiologic factors as early as the beginning of the 18th century. Work and activity-related musculoskeletal disorders (WMSD) have a complex multifactorial etiology including not only the physical aspects of the activities that people perform but also the psychosocial aspects. These disorders may involve muscular, tendinous, ligamentous, nervous tissues and include both acute as well as chronic onset. A number of sources of information ranging from biomechanics, epidemiology, and clinical case series have identified a number of major risk factors associated with development of upper limb musculoskeletal disorders. These include forcefulness, adverse posture, repetition or continuous activity, angular velocity and acceleration, or joints and duration of exposure.

Manual materials handling is defined as transporting or supporting a load, by one or more workers, including lifting, lowering, pushing, carrying, or moving a load, which, by reasons of its characteristic or unfavorable ergonomics condition, involves a risk, particularly back pain to workers (Odile, H.L.R.et al., 1999). In order words, manual materials handling can be defined as the unaided moving of objects, often combined with body twisting and awkward postures, and these conditions will contribute to musculoskeletal disorders (MSDs). Previous study had shown manual materials handling, activities such as lifting, carrying, pushing, and pulling represent an occupational risk factors that has to be confined within safe limits. Hence,

ergonomic intervention is required to ensure a worker performs the task safely and comfortably. In ergonomics study, there are various interventions that can be introduced to improve working condition. The aim of this intervention is to create and establish a safe working condition in the work environment.

However, despite these pervasive efforts to contain the hazards of manual material handlings the cost, number, and severity of injuries has either continued to grow or remains unchanged, at least in the United States. The majority of industrial manual materials handling jobs include more than one handling activity. It has been presumed that manual lifting activity limits a person's ability to perform manual materials handling activities. The complex manual materials handling task, which involved lifting, turning, carrying, and pushing activities, was also analyzed using both the old and Revised NIOSH Lifting Guidelines 1981 (Waters et al.,1993).

Manual handling of loads has been associated with shoulder disorders in some studies. It found a higher prevalence (13%) of recurrent shoulder pain for letter carriers than for meter readers (7%) and postal clerks (5%). The maximum bag weight of the letter carriers was 11.4 kg. Letter carries whose maximum bag weight had been increased by 4.4 kg had a prevalence of 23% of recurrent shoulder pain. A study was determined life-long lifting as lifted tonnes, and found an increased risk of radiographically assessed osteoarthrosis of the acromioclavicular point joint for 710 to 26000 tonnes and an even higher risk for more than 26000 tonnes. This means that an exposure-response relationship was also found for lifted load and acromioclavicular joint for arthrosis. Unfortunately, it is not known whether intensive lifting for a short period is associated with a different risk than less intensive lifting for a longer period. It should also be noted that the data on lifting were based on questionnaires and interviews with no assessment of validity.

1.2 Problem Statement

The most common form of occupational ill-health in many of today's industrialized nations is musculoskeletal disorders (MSDs) that related with manual material handling tasks. Manual materials handling activities and workstation design are the main causes for the joint pains, nerve entrapment problems, sprains and strains, and sometimes chronic and acute injuries in the body parts such as hands, wrists, arms, neck and back. In 2002, MSDs accounted for 487, 900 (34%) of injuries and illnesses in the US involving days away from work, at an estimated cost of around $2 billion annually (BLS, 2004). These problems minimize capabilities and capacities of the workers and thus negatively affect their health as well as productivity. Worker's compensation losses associated with manual materials handling is one of the most significant loss in many industry sectors (Z.Whysall, 2006).

The magnitude of the problem of work related musculoskeletal disorders is now widely documented. In the UK, these conditions form the largest category of work related ill health, with estimates for 1995 suggesting 1.2 million individuals experienced a musculoskeletal condition (HSC, 1998). Besides, there is a significant number of workers do suffer from repetitive motion injuries, as well as overexertion due to heavy lifting. The effects of overexertion in MMH activities can be short term or long term, depending upon the intensity of such activities and physical capabilities of the individuals involved. Short-term effects include sprain or muscle fatigue. Long term effects include low-back pain and accelerated disc degeneration, among other musculoskeletal disorders. That injuries resulting from MMH are not uncommon can be grasped from the fact that they now cost the United States over 150 billion dollars annually (Mital et al., 1997).

However, the risk of musculoskeletal disorders can be prevented or greatly reduced

by complying with existing safety and health law and following guidance on good practice. Unfortunately, MSDs are an increasing problem. This increasing will affects employee, employer and even government. For the employee, they cause personal suffering and loss of income. However, the employer is reducing business efficiency. Moreover, the government is increase social security costs.

1.3 Project Objectives

Manual materials handling tasks involved more than one type of activity (lifting, pushing, carrying, etc.). Manual materials handling require workers to handle the materials in good condition and avoid injuries. However, the lack of awareness of ergonomic and healthy issue among the workers had lead them under the risk of occupational diseases that may affect their health.

Specifically the project tries to achieve the following objectives:

a) To identify the musculoskeletal disorders (MSDs) experienced by the particular worker who perform manual materials handling tasks.

   This project tries to investigate the MSDs experienced by the workers while they performing manual materials handling activities in Malaysian Small and Medium Industries (SMIs). The activity of workers will be analyzed to determine whether they perform the MMH safe or not. Ergonomics risk factor is synergistic elements that contribute to MSDs hazards. Apart from that, workers will be interviewed to obtain the MSDs experienced by them such as injuries of neck and lower back pains.

b) To redesign the material handling device and workstation for working posture and lifting improvement of workers.

Four designs will be proposed in order to reduce the risk of MSDs in the workplace. Redesign the workstation can be used to reduce the MSDs due to unsafe working condition. The principle of anthropometrics is applied to the design so that it can enhance human comfort and productivity. However, redesign a manuals material lifting devices are need in order to reduce the MSDs due to the awkward posture while lifting objects.

c) To evaluate the effectiveness of the proposed solutions.

The solutions have been proposed will be evaluated to determine the effectiveness of them. The positive results may enhance the occupational health and reduce the MSDs experienced by the workers thus increase the production rate.