UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Assessment of Working Posture in Manufacturing Industry Using RULA Method

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

By

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ABSTRAK

Sektor industri pembuatan adalah satu daripada bahagian industri yang memberi sumbangan dalam mencapai Visi 2020. Kebolehan pekerja diperlukan dalam menerajui industri pengeluaran produk. Malangnya, banyak kes penyakit berkaitan sistem badan yang dikenali sebagai Cumulative Trauma Disorder (CTD) yang selalu dikaitkan dengan postur badan ketika bekerja. Tambahan itu, rekabentuk kawasan kerja yang tidak sesuai akan menjadikan kerja lebih sukar, meletihkan, melesukan, bosan dan tidak selesa. Tesis ini melancarkan tiga objektif utama yang dijalankan disalah sebuah syarikat pembuatan yang berkaitan. Pada asasnya, objektif tesis ini adalah mengenalpasti tindak balas pekerja untuk menganalisa postur bekerja di dalam kawasan kerja semasa dan menganalisa keberkesanan rekabentuk yang diusulkan. PRYM Consumer (M) telah menerima projek ini dan bersetuju bahawa projek ini boleh dilakukan di dalam syarikat tersebut. Dua seksyen utama dalam syarikat telah disiasat yang mana cara yang digunakan untuk mengenalpasti tindakbalas pekerja ialah melalui pengedaran borang kaji soal selidik yang diagihkan kepada setiap pekerja. Bagi menganalisa postur bekerja di kawasan kerja semasa ialah melalui markah RULA. Rekabentuk kawasan kerja semula dianalisa dengan membezakan hasil sebelum dan selepas penambahbaikan. Hasil tesis ini dibahagikan dalam tiga seksyen utama iaitu tindak balas pekerja adalah dikenalpasti bahawa pekerja sedar akan kesakitan badan yang mereka rasai. Kebanyakan pekerja didedahkan dengan ketidakselesaan bahagian atas badan (iaitu dari pinggang ke atas) yang banyak menyumbang risiko. Markah RULA daripada kawasan kerja semasa menunjukkan postur badan pekerja yang terdedah pada risiko ergonomik. Rekabentuk semula kawasan kerja menunjukkan beberapa pembaikan dalam postur bekerja yang menghasilkan markah RULA yang lebih rendah. Secara kesimpulannya, melalui kaji selidik, tindakbalas asas dan penjelasan kasar dapat difahami. Analisis postur pekerja serta kawasan kerja menggunakan markah RULA adalah sesuai untuk mengenalpasti masalah dalam syarikat ini.

ABSTRACT

Manufacturing industry sector is one of industrializing parties that gives significant contribution in achieving the vision of 2020. The ability of human workers is compulsory in letting the industry to be successful in producing products. Unfortunately, many of painful afflictions of musculoskeletal system, known as Cumulative Trauma Disorder (CTD), are associated with the working postures. In additional with, improper design of a workstation would make the task more difficult, strenuous, fatiguing, boring, and uncomfortable. This thesis is addressing three objectives which are projected in a chosen manufacturing company. Basically, these thesis objectives are to identify the response of workers, to analyze working postures at the current workstation and redesign together with analyzing the effectiveness. PRYM CONSUMER (M) has accepted this research and agreed that this case study conducted in PRYM CONSUMER (M) Company. Two major sections of the company have been investigated. The method to identify response is by questionnaires that distributed among the workers. To analyze working posture at the current workstation is done by assessing it by RULA method. The redesigning occurs when it is needed and the effectiveness of the proposed designs is analyzed by comparing before and after results. The results of these thesis is divided into three main sections which is the response of workers is identified that the workers are alert of the pain of their body part. Most workers are exposed to the upper limb discomfort which is contributed to the over reaching and awkward postures. The RULA score from current workstation design has shown that the workers postures are exposed to many ergonomic risks. The redesigns of workstation show several improvements on the working postures that is resulting lower RULA score in the final score. The effectiveness of the redesign has been proved by many of the RULA score is basically lowered and all the working posture involved is well analyzed and a total improvements are addressed. Conclusively, through questionnaires, basic response and a rough explanation on the working conditions is understood. The current working postures and redesign of workstation analysis is sufficient to detect the problem that occurs in the workstation.

DEDICATION

To My Siblings;

Juliana Aryati bt Ramli

Zarina Hasra bt Ramli

Ratna Zuarni bt Ramli

For your love, encouragement, and support on this project was absolutely invaluable.

To My Respectful Supervisor;

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For your support, love and demonstration of the values of education since I'm still a little kid. Love you so much.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

PSM	-	Projek Sarjana Muda
RSI	-	Repetitive Strain Injuries
CTS	-	Carpal Tunnel Syndrome
MSDs	-	Musculoskeletal Disorder
CTD	-	Cumulative Trauma Disorder
RULA	-	Rapid Upper Limb Assessment
REBA	-	Rapid Entire Body Assessment
OSHA	-	Occupational Safety Health Administration
OWAS	-	Ovako Working Posture Analyzing System
HAMA	-	Hand-Arm-Movement Analysis
LMM	-	Lumbar motion monitor
EMG	-	Electromyography

CHAPTER 1
INTRODUCTION

This chapter will expose the significant background of the study. The main focus is to explain about the study and the objectives in addressing this study. This chapter also consists of problem statements, objectives, scopes and limitations of the study, and thesis outline.

1.1 Project Background

Malaysia's major industries are based on manufacturing, tin, rubber, palm oil, and textiles, accounting for 37.5% of gross domestic product and 36% of the workforce. Manufacturing, owing to its favorable investment environment, is a major export sector of the economy. Manufacturing industry sector is one of industrializing parties that gives significant contribution in achieving the vision of 2020. Positive developments have occurred in all spheres of manufacturing industry since 1990s (Rampal et al., 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 et al., 2005). Process involved in manufacturing are consuming the workload of workers, Manufacturing industries involves activities in which the manufactured product is itself used to make other products. It also involves making products from raw materials by means of various processes, machinery, and operations, through a well-organized plan for each activity required.

Basically, processes that may involve in producing the product is such as bending, pressing, and commonly final process is packaging. These processes are in somehow requiring manpower in order to produce the product. The ability of human workers is compulsory in letting the industry to be successful in producing products. However, many industrial workstations are poorly designed; resulting in lost worker productivity and unnecessary injury at the workplace (Biman Das et al., 1996).The process of making the products may forces human to be in a state of the pain and may occur fatality. Social Organizational Safety Malaysia (PERKESO) is an organization that is committed to ensure socio-economic security of all working Malaysian citizens including their dependants. Most of the workers in Malaysia are registered with PERKESO that will cover them if they experienced any injury during the duration of working. From the statistic by PERKESO for the year 2004, they are about 10,238,554 registered workers but only 4,567,365 are active workers. From the statistic, they are about 69,132 registered accidents with 9,381 cases of permanent disable and 846 of death cases.

As a result of the certain processes that require worker to bend or reach behind limits that will bring hazard to the particular workers, many painful afflictions of musculoskeletal system, known as Cumulative Trauma Disorder (CTD), are associated with the working posture (Sengupta K., 1996). Manual tasks in different industries are performed in variety of ways where the workers have to maintain basic postures such as sitting, standing, walking, crouching or combination of various postures (Dahalan J., 2005).

In preventing injury such as MSD (Musculoskeletal Disorder) and increasing productivity generally requires an application of ergonomics (Adams S., 2005). The intervention of ergonomic is used to bring solution to encounter the problem of awkward postures, repetitions, and force that involved in working postures. A tool such as RULA (Rapid Upper Limb Assessment) method is adapted in order to analyze and assess the working posture.

1.2 Problem Statements

Knowledge of the context and type of working postures is necessary in order to examine the associations with health related outcomes (Taylor et al. , 2005). The categories for working postures distinguished between different types of exposure to standing, sitting, and sit-stand work posture (Messing K. et al. , 2004). Several issues have been brought up to this matter such as:

i) Many of painful afflictions of musculoskeletal system, known as Cumulative Trauma Disorder (CTD), are associated with the working postures (Sengupta K., 1996).

ii) According to Dahalan J (2005), manual tasks in different industries are performed in a variety of ways where employees have to maintain basic posture(s) such as sitting, standing, walking, crouching, etc. or combinations of various postures. Depending on the type of task performed, the correct basic body posture is important because it can affect productivity, product quality, and safety and health of the employees.

iii) The applications of workstation design are also important where work should be arranged accordingly so that it may be done either in seated or standing position. Improper design of a workstation would make the task more difficult, strenuous, fatiguing, boring, and uncomfortable (Dahalan J, 2002).

iv) Injuries and illness due to muscle, joint, and bone disorders from physical jobs account for more than 34% of all injuries that result in lost workdays, costing employers $15 or $20 billion a year in worker compensation charges (OSHA, 1999).

v) Many industrial workstations are poorly designed, resulting in lost worker productivity and unnecessary injury at the workplace (Biman Das et al, 1996).

A proper posture and an appropriate workstation design can contribute towards maintaining the safety and health of people at work. This project will basically bring the solution or recommendation of the problem statement.

1.3 Project Overview

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

i) To identify the workers response on the current workstation and work posture in manufacturing industry

One of the observation methods has been developed to identify and analyze the working posture in the manufacturing industry. Where these projects will only covering questionnaires distribution at manufacturing industry in Malaysian Small and Medium Industries (SMIs) in order to identify response of the workers. These questionnaires are distributed in three main departments which are bending, pressing, and packaging process are involved. 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.

ii) To analyze the working posture of worker at the current workstation design.

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), or rapid Entire Body Assessment (REBA) (Hignett and McAttemney, 2000). The result obtained from the problem regarding to working posture is assessed and analyzed using one of the tools. CATIA Software simulation is used to analyze the impact of current working posture based on the current workstation design.

iii) To propose solution based on the result.

This stage requires redesigning of existing workstation and selection of suitable means to encounter the occupational risk factors. Designing proper workstation design can be achieved by using design software such as AutoCAD, Solidworks and CATIA.

iv) Evaluate the effectiveness of proposed design practice.

The evaluation takes place where the before and after the ergonomic interventions. Through the RULA score between before and after implementations of ergonomic, it will expose the effectiveness of the proposed design.

1.4 Objectives of the Project

The objectives of this project are such as:

i) To identify the workers response on the current workstation and work posture in manufacturing industry.

ii) To analyze the working posture of worker at the current workstation design.

iii) To redesign and evaluate the effectiveness of the proposed design.

1.5 Scope and Limitation

This section is 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 company categorized in Small and Medium Industry (SMIs). In this company, workers are basically performing two main processes in producing safety pins. The processes are bending, pressing and packaging process. 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 working postures in workplace using ergonomics approach. The physiology of worker such as working postures and anthropometric data measurement are gained.

1.6 Outline of Thesis

This thesis addresses a study of working postures in manufacturing industry. Chapter 1 explains the definition of the title, problem statement and the scope of the research which enable to understand the reason of this thesis to be developed. While Chapter 2 discussed design implementation tools, design of the workstation, risk factor, and ergonomic related injuries in each of the standing and seated workstations. The following chapters, which is Chapter 3 focused on the methodology on to how to identify response among workers, and analyze data and evaluate work postures. Chapter 4 (Results and Analysis) will show the findings. Chapter 5 will address the area to be discussed. Meanwhile, chapter 6 will conclude the entire findings. In chapter 7 also, there are description of future work that are about to be done in conjunction for the next studies about ergonomics.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

According to Joseph (2003), ergonomics is a multidisciplinary science dealing with the interactions between people and their total workplace environment. A few of the disciplines involved include anthropometry, biomechanics, psychology, industrial hygiene, and safety. In simpler terms, ergonomics is the science of designing the workplace environment to fit the capabilities of workers.

This literature review will discuss thoroughly on the issue that is related with ergonomic in manufacturing industry. In industrial workstation design, the primary concern has usually been the improvement of the performance of the equipment. But, less consideration is given towards matching the abilities of the operator with the task requirement. Ergonomic workstation design encourages good posture (R. S Bridger, 2003).

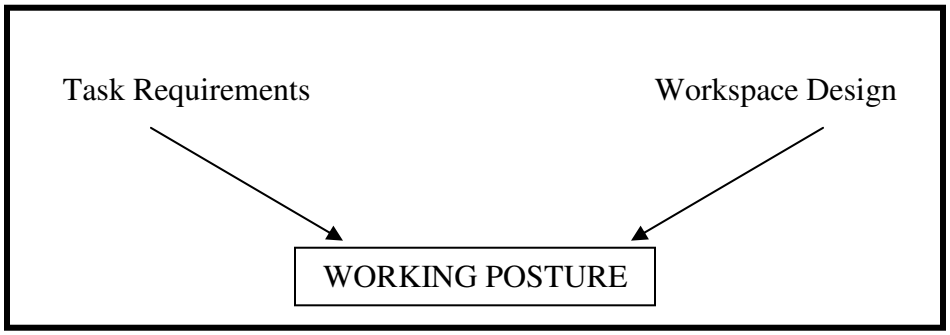

Figure 2.1: The Postural Triangle. (Bridger, R.S, 2003)

Unfortunately, today many industrial workstations are poorly designed, resulting in lost worker productivity and unnecessary injury at the workplace (Biman Das et al., 1996). Steps that should be taken by industries to make ergonomic applicable is through enforcement and creating awareness for the employees. This clearly shows that ergonomic has a significant importance in manufacturing industry. These manual tasks in industries are performed in variety of ways such as sitting, standing and sit-stand work posture (Dahalan J., 2003.). Many painful affliction of musculoskeletal system, known as Cumulative Trauma Disorders (CTD) in manufacturing industry, are associated with these working postures (Armstrong et al., 1982).

2.2 Potential Benefits of Ergonomics

The goal of Ergonomics according to Joseph (1994) is to improve the safety, comfort, and efficiency of the workplace. The benefits resulting from the application of ergonomics also include:

i) Reduction of back and upper extremity musculoskeletal injuries and/or illnesses.
ii) Reduced workers compensation costs.
iii) Higher employee satisfaction.
iv) Improved employee comfort.
v) Reduced OSHA compliance risk.
vi) Improved productivity.
vii) Improved quality of workmanship.
viii) Greater efficiency.
ix) Reduced scrap.
x) Lower employee turnover.
xi) Reduced absenteeism.
xii) Improved labor relations.
xiii) Reduced equipment damage.
xiv) Reduced rework.

Industries increasingly require higher production rates and advances in technology to remain competitive and stay in business. As a result, jobs today involve:

i) Frequent lifting, carrying, and pushing or pulling loads without help from other workers or devices;
ii) Increasing specialization that requires the worker to perform only one function or movement for a long period of time or day after day;
iii) Working more than 8 hours a day;
iv) Working at a quicker pace of work, such as faster assembly line speeds; and

If work tasks and equipment do not include ergonomic principles in their design, workers may have exposure to undue physical stress, strain, and overexertion, including vibration, awkward postures, forceful exertions, repetitive motion, and heavy lifting. Recognizing ergonomic risk factors in the workplace is an essential first step in correcting hazards and improving worker protection. Ergonomists, industrial engineers, occupational safety and health professionals, and other trained individuals believe that reducing physical stress in the workplace could eliminate up to half of the serious injuries each year. Employers can learn to anticipate what might go wrong and alter tools and the work environment to make tasks safer for their workers (US Department of Labor, 2000).

2.3 Impacts of Lack Ergonomic Awareness

In the mean time, according to Joseph (1994), ergonomic risk factors are conditions of a job, process, or operation that contribute to the risk of developing CTDs (Cumulative Trauma Disorders). Risk factors are regarded as synergistic elements of ergonomic hazards which must be considered in light of their combined effect in inducing CTDs. Jobs, operations, or workstations that have multiple risk factors will have a higher probability of causing CTDs, depending on the relative degree of severity of each factor.

2.4 Working Posture

The working posture and task should be designed to avoid strain and damage to any part of the body such as the tendons, muscles, ligaments and especially the back (Dahalan J., 2005). Knowledge of the context and type of postures is necessary in order to examine their associations with health related outcomes (Taylor et al., 2005). During work, employees subconsciously tend to accept and adapt to unsatisfactory working conditions. They may not realize that their body is under strain until they feel actual pain and even then they may not understand the causes.

Manual tasks in different industries are performed in variety of ways where employees have to maintain basic body postures. There are three main working postures that exist in the common industries which are standing posture, standing posture, and sit – stand posture. A workstation can either be designed for tasks to be performed while standing or sitting postures.

2.4.1 Standing Workstation

A standing workstation is defined as a workstation where a task is performed with the employee standing in a relatively stationary position and without much leg movement (Dahalan J. , 2005). In the standing position the body is held upright by the big muscles of the trunk and lower limbs. The employee stands throughout the length of the work shift and he or she does not move from one station to another.

According to Dahalan J (2003), the type of work done in the standing workstation can be categorized as light, medium, to heavy work depending on whether the employee is required to exert downward forces and manipulate heavy objects.
A workstation can either be designed for tasks to be performed while standing, sit – stand or sitting. Employee is required to stand while working due to one or more situations listed below:

i) The workstation provides no or limited knee or foot clearance and therefore the task cannot be performed in a seated position.

ii) Extended reaches are beyond an arm length (above, forward or below) where the upper part of the body has to bend forward to reach.

iii) Frequent distance movements and if the operator is sitting, he / she may require standing up.

i) Downward force to be exerted by the hand is more than 4.0 kg or the object weight handle is more than 4.0 kg (Dahalan J, 2003)

ii) Reduce visibility.

Figure 2.2: Examples of Standing Postures.

(Source: http://www.osha.gov/SLTC/etools/computerworkstations/positions.html)

2.4.1.1Related Injuries in Standing Posture

According to Dahalan J, 2003 improper design of standing workstation may create risks the employee's body system due to:

i) Localized fatigue that can cause pain and discomfort to the muscles of the back, neck and shoulders, and the joints of the knees, ankles, hips, shoulder, and elbows.