UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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HUMAN ACTIVITY ANALYSIS USING DELMIA ERGONOMICS IN JTKP MACHINING TECHNOLOGY LABORATORY (LATHE)

This report is submitted in accordance with the requirement of Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Manufacturing Engineering Technology (Product Design) with Honours

by

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DECLARATION

I hereby, declare that this thesis entitled "Human Activity Analysis using DELMIA Ergonomics in JTKP Machining Technology Laboratory (Lathe)" is the result of my own research except as cited in references.

Signature : .....

Name : .....

Date : .....

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as one of the requirements for the award of Bachelor of Manufacturing Engineering Technology (Product Design) with Honours. The member of the supervisory is as follow:

.....

(Supervisor)

ABSTRAK

Projek ini bertujuan untuk mengkaji dan mensimulasi beberapa tugas manusia yang berkaitan dengan keupayaannya semasa mereka menggunakan mesin larik di JTKP Makmal Teknologi Pemesinan. Pemerhatian akan dijalankan pada 3 orang lelaki pelajar dan 3 orang perempuan pelajar Fakulti Teknologi Kejuruteraan (FTK) dengan kategori ketinggian pada tinggi, sederhana dan pendek. Postur kerja mereka semasa melakukan set-up prosedur pada mesin pelarik akan direkodkan dan diambil gambar. Berdasarkan pemerhatian, susun atur kerja di makmal mesin pelarik akan direka bentuk menggunakan software CATIA V6. Satu manikin akan dimasukkan dan diedit berdasarkan data antropometri yang dikumpulkan daripada responden pelajar. Selepas itu, analisis aktiviti manusia akan disimulasi dengan menggunakan analisis DELMIA Ergonomik. Postur kerja responden akan dianalisis dan dijustifikasi dengan menggunakan kaedah Rapid Upper Limb Penilaian (RULA). Berdasarkan skor RULA, postur kerja yang tersesuai semasa menggunakan mesin pelarik akan dicadangkan untuk mengurangkan risiko daripada mengalami Musculoskeletal Disorders (MSD). MSD adalah salah satu penyakit yang disebabkan oleh manual pengendalian tugas seperti mengangkat, menolak dan menarik. Operasi menggunakan mesin pelarik telah dikenal-pasti melibatkan beberapa jenis aktiviti pengendalian manual.

ABSTRACT

This project aims to study and simulate several human's task related to human capabilities while using lathe machine in JTKP Machining Technology Laboratory. Observation has been conducted on three males and three females students group of Faculty of Engineering Technology (FTK) with the height category in tall, medium and short. The respondents working postures while doing set-up procedures on lathe machine had been recorded and photographed. Based on the observation, the working layout in lathe machine laboratory was designed using CATIA V6 software. A lifelike manikin was inserted and edited based on the anthropometric data collected from the respondents. Then, the human activity analysis was simulated by using DELMIA Ergonomics analysis. The respondents working postures was then analyzed and justified by using Rapid Upper Limb Assessment (RULA) method. Based on the RULA scores, the ideal working postures while working on lathe machine was proposed to minimize the risk from suffer Musculoskeletal Disorders (MSD). MSD is one of the sicknesses caused by manual handling task such as holding, lifting, carrying, pushing and pulling. Lathe machine operations has been identified involve several kinds of manual handling activities.

DEDICATION

To my beloved parents

Tan Say and Thong Gek Choo

Raise me to become who I am

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I would like to express my gratitude to my supervisor, Encik Mohd. Faiz bin Wahid who guides me through completing this project. He gave me a lot of advice, ideas and confidence to complete this project. Besides, I would like to thank Faculty of Engineering Technology of University Teknikal Malaysia Melaka (UTeM) for helping me in preparing formal documentations and guidelines for my project report. Not to forget, my families and friends for their support and blessing.

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LIST OF ABBREVATIONS, SYMBOLS AND NOMENCLATURES

BDP	-	Bachelor Degree Project
CATIA V6	-	CATIA Version 6
EGA	-	DELMIA Ergonomics Analysis
EGE	-	DELMIA Ergonomics Evaluation
FTK	-	Faculty of Engineering Technology
HAA	-	Human Action Analysis
HBR	-	Human Builder
HME	-	Human Measurement Edit
HPA	-	Human Posture Analysis
LBP	-	Lower Back Pain
MSD	-	Musculoskeletal Disorders
NIOSH	-	National Institute for Occupational Safety and Health
OWAS	-	Ovako Working Postures Assessment System
REBA	-	Rapid Entire Body Assessment
RULA	-	Rapid Upper Limb Assessment

CHAPTER 1
INTRODUCTION

1.1 Background

First of all, ergonomics is the study of human in the working environment. Ergonomics also concerned with the comfort, health and safety, and productivity. Nowadays, ergonomics is very important in any subject of field because it provides us a way to analyze our body postures when our body is under any ergonomics risk factors. All of this risk factors will contribute to Musculoskeletal disorders (MSD) are the disorders where the human body gets traumatized over a period of time. Many industry always overpass these types of disorders where it tend to cause the sickness slowly appeared within the workers body. In fact, this problem can be foreseeable when time passed by. Therefore, ergonomic analysis should be done to overcome this kind of diseases so that everyone has a healthy and comfort posture when doing their job every time.

This project is mainly focused on the human activity analysis using DELMIA V6 Ergonomics. The ergonomics human activity analysis for this project is aimed to focus on various working postures of students while they are using lathe machine in JTKP Machining Technology Laboratory. Since ergonomics is a study of human's activity with workspace, the working layout in lathe machine laboratory has an indirectly influences on the analysis. The study was not only concentrated on the working postures of students while using lathe machine. The movements of students while taking materials from the tool room and referring working procedures at work table had been focused too. Then, the study had paid full attention on the hand

actions while processing the lathe machine. Vertical and horizontal reaches of upper parts of body as well as position of visual display was taken in consideration too.

The approach that was used to perform the human activity analysis is by using the DASSAULT SYSTEMES software, CATIA V6. This software allows users to do the DELMIA Ergonomics analysis. A 3D virtual environment and lifelike manikins can be created to perform the working tasks. Users can analyze and predict the comfort or safety scoring of the working postures by observing color coding of Rapid Upper Limb Assessment (RULA) analysis. RULA is a method for analyzing risk factors to the upper limb of the user-defined manikin or human in an actual physical environment. The RULA analysis can measures several risk factors such as body movements, static work load, force, working posture and time worked without a break.

1.2 Problem Statement

This study was focused on the human activity analysis while students using lathe machine in laboratory, which can carry out several machine procedures. From several research studied, many lathe machine workers suffering MSD on the neck, shoulders, trunk, and lower back region. All these disorders are mostly causes from prolonged unhealthy postures while working, lower back support is inadequate and poor ergonomics workstation set up. Since there are no specific ergonomics guidelines and assessment implemented in JTKP Machining Technology Laboratory, therefore the student's activities when operating the lathe machine will be observed and analyzed using anthropometric data gathered from a specific group of students.

1.3 Objectives

The main objectives in this project are:

i. To study and simulate several human's task related to human capabilities while using lathe machine in JTKP Machining Technology Laboratory.
ii. To identify and propose the ideal working posture while working on lathe machine to minimize the risk from suffer MSD.
iii. To identify relevant collected anthropometric dimensions in human-machine interaction that could be related to awkward working postures.

1.4 Scope of the study

The scope on this project covers on:

i. Using DELMIA V6 Ergonomics software to study and simulate human activity.
ii. Observe and analyze the laboratory work on lathe machine.
iii. Rapid Upper Limb Assessment (RULA) ergonomics analysis will be used based on recommendations from National Institute for Occupational Safety and Health (NIOSH).
iv. Observe on 3 male and 3 female students group of Faculty of Engineering Technology (FTK) with the categories of height in tall, medium and short while doing set-up procedures on lathe machine.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

For further process of this research project, literature review makes an important key of it. The sources of literature survey are obtained from the books, journals and also electronic resources. All of the information was based on the past studies related to ergonomics fields. Therefore, it had covers on the study of workplace evaluation, ergonomics in the lathe laboratory, ergonomics assessment tools and DELMIA Ergonomics based on CATIA V6.

2.2 Workplace Evaluation

2.2.1 Working Postures

Working posture can be defined as the posture of an individual required to perform a job. Work posture in the workplace is determined by the interaction of many factors, including working method, workstation layout and equipment design. In addition, the body-size characteristics of a worker interact with all the workplace factors determines specific postures used to perform a job. Awkward working postures occur when there was a mismatch between a worker's body size and the job requirements [1]. **Figure 2.1** showed the risk factors of awkward working postures.

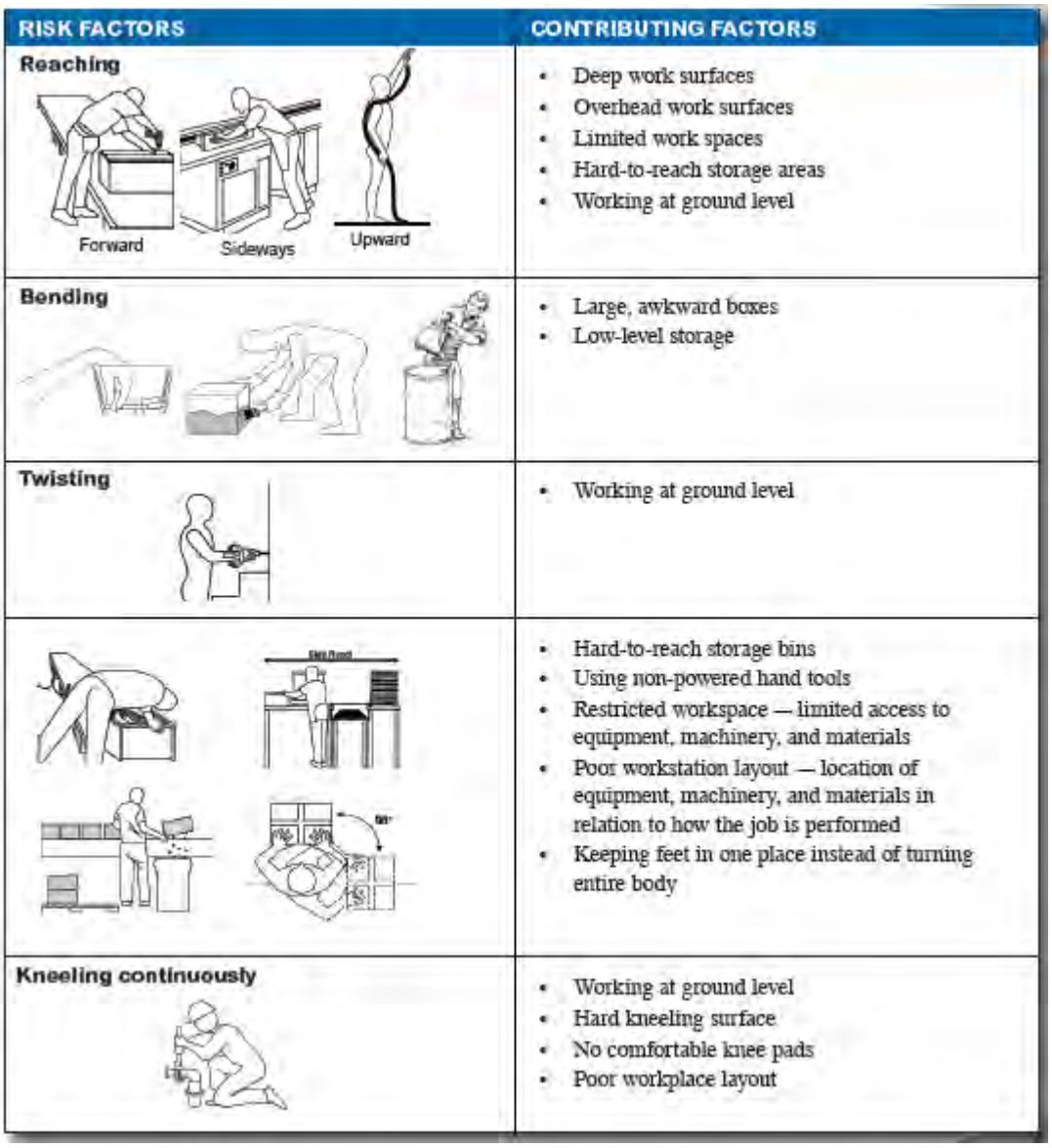

Figure 2.1: The risk factors of awkward working postures Source: Safety in Manufacturing, 2000].

Awkward working postures are caused by the joints position of body that is not moving in neutral range of postures. Movement of joints such as bending the neck forward more than 30 degrees, raising the elbow above the shoulder, bending the back forward greater than 45 degrees and squatting will lead to extreme awkward postures. To avoid awkward working postures, the joints of body should maintain in a neutral range of postures. Postures within the neutral range can contribute in high force production or control of body and reduce the stress apply on the tissues, muscle, nerves and bones. **Figure 2.2** showed the descriptions of neutral postures midpoints for the body joints.

Joints	Descriptions of Midpoints for Neutral Range of Postures	
Head and Neck	Level, or bent slightly forward, forward facing, balanced and in-line with torso	
Hands, Wrists & Forearms	All are straight and in-line	
Elbow	Close to the body and bent 90 to 120 degrees	
Shoulders	Relaxed and upper arms hang normally at the side of the body	
Thighs and Hips	Parallel to the floor when sitting; perpendicular to the floor when standing	
Knees	Same height as the hips with feet slightly forward when sitting; aligned with hips and ankles when standing	
Back	Vertical or leaning back slightly with lumbar support when sitting; vertical with an S-curve when standing	

Figure 2.2: Descriptions of Neutral Postures Midpoints for the Body Joints [Source: Ergonomics, 2009].

2.2.2 Working Layout

The design of workstation was one of the important ergonomics approach in manufacturing industry but this approach can be easily ignored by people. With a little consideration to the anthropometric measurements of the anticipated user, the manufacturing workstation was often designed in an arbitrary manner. A slightly change in the dimension of workstation can bring the impact to worker health, safety and also effect on industry productivity.

There were many guidelines and principles in the design of workstation. One of it was apply the anthropometric data to workspace design. This mean the dimension for workstation design is determine according to the anthropometric data while doing industrial tasks such as reaching, sitting, standing and sit-stand positions. The populations for male and female workers consist of 5^{th}, 50^{th} and 95^{th} percentiles based on the existing anthropometric data. The design of reaching limits and clearance requirements were based on the smaller (5^{th} percentile) and larger (95^{th} percentile) dimensions of individual worker. The zones for reaching and clearance were shown in **Figure 2.3**.

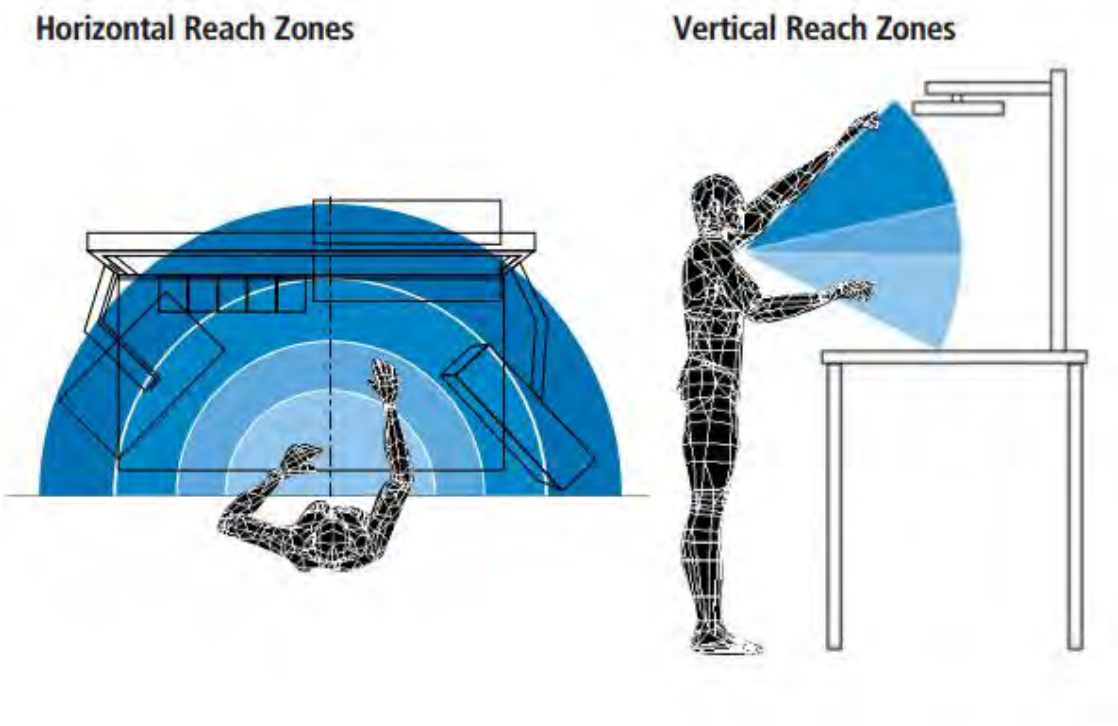

Figure 2.3: Horizontal and vertical reach zones of a worker in a workstation [Source: Lista making workspace work, 2012].

Besides that, to solve the workstation design problems, Ernest J. McCormick had stated out four principles of rational workspace layout, which are [5]:

- Importance principle: The most important items should be in the most accessible locations.
- Frequency of use principle: The most frequently used items should be in the most accessible locations.
- Function principle: Items with similar functions should be grouped together.
- Sequence of use principle: Items that are commonly used in sequence should be laid out in the same sequence.

2.2.3 Musculoskeletal Disorders (MSD)

The term of musculoskeletal disorders (MSD) donate to the disease or damage of the muscles, tissues, nerves, joints or tendons at the body part of neck, upper limb and the back. MSD are consequences from the mismatch between the health capacities of worker and the job requirements. According to a study, it pointed that manual material handling is one of the factors that causes MSD occur [6]. Activities such as holding, lifting, carrying, pushing and pulling are all covered in manual handling tasks. **Figure 2.4** showed the body parts affect by MSD.