



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**ANTHROPOMETRIC DIMENSIONS AND PREFERRED  
WORKING SURFACE FOR THE LECTURER OFFICE**

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

**MOHAMMAD SYAFIEQ BIN SAZALI**

**B071210334**

**900928-02-5373**

FACULTY OF ENGINEERING TECHNOLOGY

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## DECLARATION

I hereby, declared this report entitled –Anthropometric Dimensions and Preferred Working Surface for the Lecturer Office” is the results of my own research except as cited in references.

Signature : .....

Author's Name : .....

Date : .....

## **APPROVAL**

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

.....

(Project Supervisor)

## **ABSTRACT**

Ergonomics science is the study of the interaction between people and machines and the factors that affect the interaction. In Universiti Teknikal Malaysia Melaka (UTeM), ergonomics still gets very little attention and there is no database which stores the anthropometric data for UTeM lecturers. The most important thing in this project is to collect all the anthropometric data of Faculty of Engineering Technology (FTK) lecturers consists of 30 males and 30 females as information to be used in the ergonomics study. Then, there is survey analysis to gather information of current work station that experience by lecturers of FTK. As the result, the awareness of ergonomics work station among FTK lecturers are not archive 50% but mostly there are comfort with their work station. Their statement about current work station is proven by the Rapid Upper Limb Assessment (RULA) analysis result. It shows the current work station is comfortable and acceptable with the real anthropometric measurements among FTK lecturers include male and female lecturers but there are some suggested investigate further. Finally, this study comes out with ergonomics work station layout as guidance for FTK lecturers.

## **ABSTRAK**

Ergonomik adalah kajian interaksi antara manusia dengan mesin atau kerja dan faktor-faktor yang mempengaruhi interaksi tersebut. Di Universiti Teknikal Malaysia Melaka (UTeM), ergonomik masih lagi mendapat perhatian yang sedikit dan tidak ada pengkalan data yang menyimpan data untuk pensyarah di UTeM. Perkara yang paling penting dalam projek ini adalah untuk mengumpul semua antropometri data bagi pensyarah Fakulti Teknologi Kejuruteraan (FTK) yang terdiri daripada 30 orang lelaki dan 30 orang perempuan sebagai maklumat yang akan digunakan dalam kajian ergonomik. Seterusnya, terdapat kajian analisis untuk mengumpul maklumat berkaitan stesen kerja yang sedia ada berdasarkan pengalaman daripada pensyarah FTK. Didapati kesedaran berkaitan isu ergonomik di kalangan pensyarah tidak mencapai 50% tetapi kebanyakan mereka selesa dengan stesen kerja mereka. Kenyataan mereka ini dibuktikan dengan hasil analisis menggunakan Rapid Upper Limb Analysis (RULA). Ianya menunjukkan stesen kerja sedia ada adalah selesa dan boleh diterima pakai dengan ukuran sebenar antropometrik di kalangan pensyarah FTK termasuklah pensyarah lelaki dan wanita. Tetapi ianya terdapat beberapa perkara yang disyorkan untuk dibuat kajian yang lebih lanjut. Akhir sekali, kajian ini mengeluarkan panduan kepada pensyarah FTK untuk menyusun atur peralatan di ruang kerja mereka.

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## **DEDICATION**

Especially for beloved father and mother:

Sazali Bin Yusof

Salmah Binti Mat Zain

To all my siblings:

Nurul Syuhada Binti Sazali

Nurul Syaqla Binti Sazali

To my supervisor and co-supervisor:

Mr. Khairum Bin Hamzah

Mr. Mohd Fa'iz Bin Wahid

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## LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

2D	-	Two-dimension
3D	-	Three-dimension
CAD	-	Computer Aided Design
CAM	-	Computer Aided Manufacturing
CATIA	-	Computer Aided Three-dimensional Interactive Application
DHM	-	Digital Human Models
LBP	-	Low Back Pain
MSD	-	Musculoskeletal Disorder
VDT	-	Video Display Terminal
RULA	-	Rapid Upper Limb Analysis
$\sigma$	-	Standard Deviation
$N$	-	No. of sample
$X$	-	Sample
$\bar{x}$	-	Mean
Ανθρωπος	-	Man
Μετρον	-	Measure

# CHAPTER 1

## INTRODUCTION

### 1.1 Introduction

Nowadays, technology is booming in all kinds of fields such as automotive, furniture, clothing, and more. This is because technology is intended to solve the problems in our daily lives. Every day, there is at least one product produced by any company. To produce a new product, several factors should be considered such as customer preference and comfortable usage. The presence of ergonomics sciences will ensure that each product is produced in accordance with the provisions of ergonomics. In other words, ergonomics is the study of the interaction between humans and machines and the factors that affect the interaction. In ergonomics, the correct way of working with any tools in the workplace must fit the human's capability to accomplish the task demands as in Figure 1.1.

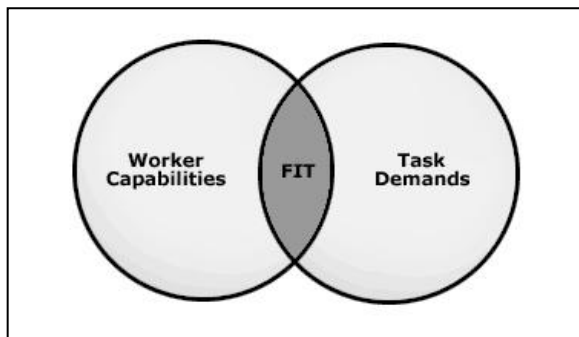


Figure 1.1: Basics of ergonomics

This is important because, according to Oroska (2013), our musculoskeletal system is affected when we are performing a task while our body is stressed by awkward posture, high temperature, or repeated motion. Due to this, our body may begin to feel symptoms such as discomfort, fatigue, and pain. All of which can be the first signs of musculoskeletal disorder (MSD). This can all be prevented with the help of ergonomics. But in Malaysia, ergonomics issues among workers are not widely recorded and documented compared to other issues such as air pollution, natural disasters, and other hazards. We have limited anthropometric data compared to other countries. According to Al-Atabi and Namasivayam (2013), anthropometry is an important part of the study of ergonomics as it deals with statistical data about the human body which can help design comfortable and optimized products and processes. Therefore, a product that is invented in this country cannot be said to follow true anthropometric data for this country's population.

Based on the issue highlighted above, this project will study at Faculty of Engineering Technology (FTK) lecturers within their offices or workplaces to see whether the workplaces satisfy the rules of ergonomics. Ergonomics science is the study of the interaction between people and machines and the factors that affect the interaction. The most important thing in this project is to collect all the anthropometric data of FTK lecturers as information to be used in the ergonomics study. Anthropometry is an important part of the study of ergonomics as it deals with statistical data about the human body which can help design comfortable and optimized products and processes. The product that is the focus of this project is the computer workstation in lecturer offices. This is because there has been an increased frequency of ergonomic injuries and illnesses related to the computer workstations. Therefore, some improvements will be made to the design of lecturer office furniture to optimize it based on ergonomics rules.



## **1.2 Objective**

Based on this study, there are several objectives that have been highlighted. These objectives will be represented as the guide to achieve the aim of this study. The objectives are listed below:

- (a) To collect all the anthropometric data appropriate with ergonomics study among FTK lecturers.
- (b) To study whether the current workstation in lecturer offices follow the ergonomics rules and anthropometric data.
- (c) To make improvements to the design of work surface at lecturer offices based on this study.

## **1.3 Problem Statement**

Nowadays, Malaysia has limited anthropometry data because of a lack of emphasis on ergonomics. Therefore, the furniture that has been designed does not follow the true specifications that should be based on anthropometric data for the Malaysian population. Likewise, in Universiti Teknikal Malaysia Melaka (UTeM), anthropometric data still gets very little attention and there is no database which stores the anthropometric data for UTeM lecturers. If the design of jobs and workstations is poor, it will inevitably cause injuries to some workers. Thus, the study on current work station must be made to identify whether it is follow the ergonomics rules and anthropometric data of FTK lecturers.

## **1.4 Scope**

This project will focus on collecting the anthropometric data appropriate with ergonomics study from FTK lecturers. By collecting the anthropometric data from FTK lecturers, it is enough to represent the anthropometric data for all lecturers in UTeM. In order to ensure the success of this project, a total sample size of 60 lecturers, which consists of 30 males and 30 females, will be taken. Research on work station design will be compared to the current design of FTK lecturer offices. Then, an improvement will be made by focusing on the work surface layout. The anthropometric measurement tools that are used come from the Ergonomics Laboratory at Technology Campus, FTK, UTeM. Other tools include CATIA, SolidWork and Microsoft Excel software which are used to complete this project study.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

Literature review is an evaluative report of information found in the literature related to the field. This is the phase where all the processes, such as searching, analysing, and collecting information that have been published by researchers, happen. All the information, including theoretical and methodological data, will be listed as references and evidence for this project. The information sources are extracted from books, journals, paper journals, etc. This literature review also references past studies in this project field.

In this chapter, there will be a literature review about everything related to the project title which is Anthropometric Dimensions and Preferred Working Surface for the Lecturer Office<sup>4</sup>. This will consist of an introduction to ergonomics, anthropometry, simulation analysis, etc.

## **2.2 Introduction of Ergonomics**

### **2.2.1 Ergonomics Definition**

According to Bridger (2003), the term ‘ergonomics’ originated from the Greek term ‘ergon’ which means work and ‘nomos’ which means law. In other words, ergonomics is the study of the interaction between people and machines and the factors that affect the interaction. Ghosh *et al.* (2011), explains that Ergonomics or human factors is the scientific discipline concerned with knowing how interactions between humans and other elements of a system happen. It is also the profession that applies principle, theory, data, and methods to design to optimize human well-being and overall system performance. Ergonomics encompasses the relationship between humans, machine systems, job design, and the work environment (Zafir Mohamed Makhbul *et al.* 2007).

According to Singh and Wadhwa (2006), Ergonomics is science that makes products fit to people. Its purpose is to create products that are simple, enjoyable, safe, and effective to use. In a nut shell, ergonomics is everything about the workings between human and machine or task demand. Chakrabarti (2005), state that ergonomics is interface between human and machine and illustrated on Figure 2.1. Mean that, it is some good conditions when people working with their tools or equipment.

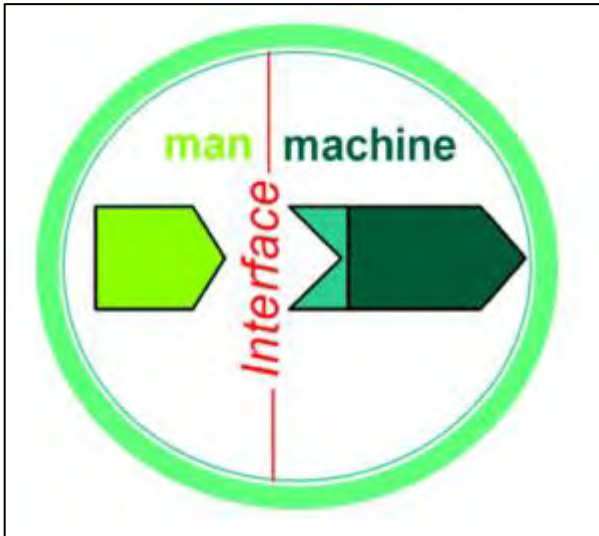


Figure 2.1 : Basics of ergonomics according to Chakrabarti (2005).

### 2.2.2 History of Ergonomics

Based on Bridger (2003), ergonomics science came about as a result of the design and operational problems presented by technological advances in the last century. It also owes its development to the same historical processes that gave rise to other disciplines such as industrial engineering and occupational medicine. Scientific management developed by F. W. Taylor and work study developed by the Gilbreths is precursors to ergonomics. Both were developed at the beginning of the twentieth century and were based on the realization that productivity could be improved by redesigning the way work was done and not just by using better machines.

Helandar (2006) states that ever since the beginning of ergonomics history in the 1950s, society and technology have advanced greatly with Human Factor Ergonomics (HFE) following in tow. The following points characterize its development over the last 50 years. Different issues have driven the establishment of our science from the 1950s to the present.

- (a) 1950s: Military ergonomics
- (b) 1960s: Industrial ergonomics
- (c) 1970s: Consumer products ergonomics
- (d) 1980s: Human-computer interaction and software ergonomics
- (e) 1990s: Cognitive ergonomics and organization ergonomics
- (f) 2000s: Global communication, internet, and virtual collaboration

### **2.2.3 Objective of Ergonomics**

According to Lenkeit (2013), the purpose of ergonomics is to fit the task demand to the individual and not the individual to the task. An ergonomist appraises the demands of a specific task with reference to the capability of the worker to perform the task over a certain time period. Each study commonly has its own proposed objective to achieve. In the ergonomics field, the main objectives can be separated into four main categories. First, the objective is to enhance in a human way, meaning ergonomics study will improve on human life especially when the work deals with machines or capable commodities. The second objective is to improve productivity of work. With ergonomics rule, it will ensure increased productivity by applying the correct way to work. It will also ensure human safety while working with machines. Ergonomics will prevent humans from getting injured easily while working. Lastly, the objective is to make the product comfortable and effective to use (Chakrabarti, 2005).

According to Australian Government Publishing Service (1991), an ergonomist's goal is to provide working conditions which are better or above the lowest requirement to ensure the health and safety of the workforce. With comfortable, productive, and satisfying office surroundings, any musculoskeletal complaints should be minimized. To design such a surrounding, it is necessary to observe not only furniture and equipment, but also the job designs, lighting, noise, air quality, office

landscaping, and personal space. Therefore, this project study will focus on the furniture and equipment as they both have a strong influence on posture.

#### **2.2.4 Important of Ergonomics**

Orosha (2013), states that ergonomics science is important because our musculoskeletal system is affected when we are performing a job while our body is stressed by awkward posture, high environment temperature, or repeated motion. Our body may start to feel symptoms, such as discomfort, fatigue, and pain, which can be the first signs of MSD.

According to US Department of Labor (2000), if task demand and equipment do not embody ergonomics principles in any kind of design, workers may have exposure to improper physical strain, stress, and overexertion, including awkward posture, awkward vibrations, forceful exertions, repetitive movement, and heavy lifting or loading. Appreciating ergonomics risk factors in the workplace is an extremely important first step in rectifying hazards and improving laborer protection. Health professionals, occupational safety personnel, ergonomists, and other trained individuals believe that by reducing physical stress in the workplace, it could eliminate up to half of the serious injuries that occur every year. Workers can learn to anticipate what might go wrong and alter their equipment and the work environment to ensure the task is safely performed.

#### **2.2.5 Physical Ergonomic Considerations in Product Design**

Based on a Nwaigwe (2005) study, physical ergonomics is conducted according to a set of corresponding principles which may seem simple and self-evident but mostly intersect in the design of some products. Taken as a whole, these principles show what

to consider in the design of products and help find ways to increase safety and comfort during user-product interaction. The principles of physical ergonomics are:

- (a) Moderate body motions
- (b) Promote postures of least stress
- (c) Minimize static load
- (d) Provide clearance
- (e) Reduce exposure to vibration and impact forces
- (f) Moderate heat build-up in person-product interface
- (g) Limit exposure to shear forces
- (h) Reduce application of excessive force
- (i) Reduce exposure to contact pressure
- (j) Reduce tissue distortion

### **2.2.6 Ergonomics Work Surface (Office)**

From a America and Mcculloch (2009) study, it states that the work surface must fit a worker. By adjusting the height of your chair, you can identify the best height for your work surface. The top of your table must be approximate to the level of your elbow. To measure the height of your elbow, your upper arms must hang relaxed beside your body while your lower arms are bent at a right angle between 90 to 110 degrees. Make your own adjustments by lowering or raising your work surface or your chair. If your table cannot be adjusted to accommodate the height of your elbow, you can raise your chair or use a suitable footrest. The size of the footrest needs to be large enough for your foot. If necessary, a keyboard tray can be used to bring the keyboard and mouse closer to the required height. The keyboard tray must be height and tilt adjustable, have compartments for both the mouse and keyboard, and should not affect your legroom. Other materials used most frequently must be located within easy reach (a better way to arrange work materials is in a semicircle). By positioning materials you do not use