UNIVERSITI TEKNIKAL MALAYSIA MELAKA

STUDY ON DESIGN OF WORKSTATION MEETING
ERGONOMIC REQUIREMENT FOR CAD/CAM LABORATORY IN
FKP, UTeM

This report summated in accordance with requirement of Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Design) with Honours

by

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FACULTY OF MANUFACTURING ENGINEERING
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Ergonomics and design have made a greatest combination in develop a product. This project discusses about the development of a workstation that ensure a comfortable environment to the consumer through the enhancement of the current workstation in CADCAM laboratory, FKP, UTeM. The objective of this project is to propose a comfortable workstation in CADCAM laboratory, FKP, UTeM that based on ergonomic requirement for the user even though they are using it for a long period. The comfort aspect in this project is based on 6 important parameters of ergonomic workstation, which is the size of chair and table, the height of table and chair, the distance between chair and table, the distance between user and computer devise, the distance between workstation and also the visibility and normal line of sight. There are two methods that will be used for data gathering which are anthropometric measurement and market survey. There are 45 respondents for market survey and most of them are FKP’s student that currently uses this lab. While for anthropometric measurement, there are 45 male and female students were taken as respondent to measure their part of body sitting posture. All the data will be used as an input for RULA analysis before developing a new design of workstation. From discussion, some of the main problem has been defined which give affect student discomfort, for example limited spaces, glare and inconsistent temperature. Furthermore, this can be explained more after RULA's analysis, where the result shows the unsatisfactory condition with the score of 5. Nevertheless, this problem has been solved when the new workstation design is developed in which the data collected and the analysis from ergonomics aspects has been implemented in the new design successfully with the score of 2. As a conclusion, this project definitely is an application of ergonomics aspect which it is used to improve the product quality by ensures the user can adapt the product in various conditions especially for using it in
longer period of time. This condition has been made by differing from one into other elements of ergonomics before considered in design.
ABSTRAK

Ergonomik dan rekabentuk telah membentuk satu gabungan yang terbaik dalam penghasilan sesuatu produk. Dalam projek ini, ia membincangkan mengenai penghasilan salah satu produk iaitu meja computer di mana ia akan memberi suasana yang keselesaan kepada pengguna dengan melakukan penambahbaikan daripada kawasan kerja yang sedia ada di makmal CADCAM, FKP, UTeM. Objektif utama projek ini adalah untuk membuat atau mencadangkan penambahbaikan pada kawasan kerja terutama ketika para pengguna bekerja pada jangka masa yang lama, pada masa yang sama pembangunan kawasan kerja juga dilakukan di makmal ini berdasarkan keperluan dari segi aspek ergonomik. Di dalam projek ini, aspek keselesaan adalah berdasarkan 6 parameter ergonomik tempat kerja, iaitu saiz kerusi dan meja, tinggi kerusi dan meja, jarak antara kerusi dan meja, jarak antara pengguna dan computer, jarak antara tempat kerja dan juga jarak penglihatan dan penglihatan normal. Seramai 45 orang pelajar dari FKP, UTeM akan dipilih dalam memberi reaksi dari ketika keadaan badan duduk. Kesemua data yang telah diambil akan digunakan di dalam analisis RULA sebelum suatu rekabentuk kawasan kerja baru dibina. Di dalam perbincangan yang dibuat, terdapat beberapa masalah utama telah dikenalpasti yang mana penyebabkan ketidakselesaan pelajar, sebagai contoh keadaan ruang kerja yang terhad, pencahayaan cahaya terlalu terang dan suhu bilik yang tidak sekata.. Ini dapat diperjelaskan lagi setelah menggunakan analisis RULA, dimana terdapat keputusan yang diperolehi daripada keadaan sebenar kawasan kerja adalah tidak memuaskan iaitu dengan permakahan 5. Namun begitu, segala masalah ini dapat diatasi setelah pembinaan rekabentuk baru di mana ianya adalah hasil daripada implimentasi data-data terkumpul dan kajian daripada aspek ergonomik, dengan permakahan 2. Keseluruhan keputusan yang diperolehi, ada terdapat dipenghujung kandungan projek ini. Secara
kesimpulannya, projek ini adalah berdasarkan aspek aplikasi ergonomik yang mana ia digunakan untuk menambahk kualiti produk dengan memastikan pengguna dapat menggunakan ia dalam pelbagai variasi terutama untuk penggunaan yang lama. Keadaan ini dibuat dengan berdasarkan keseluruahn ergonomic elemen sebelum ianya dipertimbangkan dalam rekabentuk.
DEDICATION

Especially for beloved father and mother:
   Mohd Salleh Bin Abdul Rahman
   Hasipah Binti Tah

To all my siblings:
   Iylia Farhana Binti Ismail
   Mohd Ikhwan Hafiz Bin Md Noor
   Mohamad Azril bin Mohamad Noor
   Muhammad Azfar Bin Abdullah
   Nur Hidayah Binti Mohamed Hussin

To my supervisor and advisor:
   Mrs. Suriati Binti Akmal
   Mr. Isa Bin Halim
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<tr>
<td>BCE</td>
<td>Before century</td>
</tr>
<tr>
<td>FKP</td>
<td>Fakulti Kejuruteraan Pembuatan</td>
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<tr>
<td>IEA</td>
<td>International Ergonomics Association</td>
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<tr>
<td>MSD</td>
<td>Musculoskeletal Disorders</td>
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<tr>
<td>RULA</td>
<td>Rapid Upper Limb Assessment</td>
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<tr>
<td>UTeM</td>
<td>Universiti Teknikal Malaysia Melaka</td>
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<td>VDT</td>
<td>Video Display Terminal</td>
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1.1 Introduction

Since early nineties, the numbers of people using computers are growing, either for their work or for personal usage. Computer usages are not restricted to a person's age, whereby everyone can use it including adult and child. However, use a computer for longer period will cause an uncomfortable situation. This problem often becomes important issue especially in designing a workstation.

A few factors in designing a workstation should be taken into consideration like cost, ergonomic requirement, customer requirement, work requirement and space and layout requirement. In ergonomic, scope that there were in it is too widespread where it focuses on the role of human in complex system, for the design of equipment and facilities for human use, and the development of environment comfort and safety. In this project, it only covers the development of environment comfort and safety workstation. The field of this project is focuses on the workstation design in which the design shall emphasize on the work sitting posture.

In this case, an optimal workstation design is where the workstation environment supports the needs of users in a comfortable environment. This is the goal of ergonomics in workstation design. Dempsey et al. (2004) states that an ergonomics workstation design can effectively enhance productivity and minimize stress through the interaction between the various systems components.
Ergonomic in workstation is very important in which, if the workstation did not ergonomically designed, the users may expose to under discomfort posture and also affect the vision sight. However, each individual may experience symptoms differently. All of this issue has been discussed in Visual Display Terminal (VDT), it was an interaction between two systems posture and vision. Ankrum (1997) classifies that VDT is focuses more on neutral poster for head/neck angle and eye level. Beside that, the others method that used in ergonomic is anthropometrics data. Pheasant (1998) state the branch of human sciences with body measurements such as body size, shape and strength. This is used by ergonomists to ensure that products, such as seats it and suit as many users as possible.

Leaman (1995) states, sometime a discomfort of workstation was caused by the environment such as temperature level, draughty or harassed through lack of privacy or distraction will affect users to perform their work properly. However, by approaching work practices (stretching, reaching, or sitting) from an ergonomically correct point of view, a user actually becomes stronger, healthier and more productive. Helander (1991) describe many researches have shown positive effects in reducing work stress by applying ergonomic principles in workplaces, machine design, job design, environment, and facilities design.

1.2 Objective

The objectives of these projects are:

(a) To define the comfort factor that influences the most while using CADCAM lab.
(b) To increase the efficiency and create a comfortable environment for student by creating a new design for workstation.
1.3 Problem Statement

The ability to sit comfortably for a longer period while using a computer is merely impossible. This situation happened because the workstation and body poster are in an unsuitable position while working such as muscle tension, disc pressure and lack of body support. Based on this situation, it can be ensured that ergonomic workstation design would be vital in seeking and resolving a comfortable workplace. Therefore, a study on designing of workstation based on ergonomic view will be conducted in the CADCAM laboratory at FKP.

1.4 Scope

As mention in previous section, this project is to study workstation in CADCAM for learning purpose, which related to facilities design based on ergonomic requirement. In this project, it more focuses on student and lectures that using this lab. The scopes of this project are:

(a) The study will be conducted by taking direct measurement on anthropometric data and survey. The result will be taking as RULA input parameter in order to define comfort parameter.
(b) Some of the comfort parameter is define as size of chair and table, height of table and chair, distance between user and computer, distance between workstation and eye sight.
(c) RULA software is used for data analysis and at the end an ergonomic workstation will be proposed
(d) Questionnaires will be distributed to the user that had been used CADCAM laboratory. The accuracy and standard deviation from the questionnaires will be used as result.
CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

In this chapter, it contains a discussion of all the matter that relates with the project, such as history of ergonomics, purpose of ergonomic, workstation design, anthropometric, RULA, and the performance parameter. Apart from that, it is also brief out the important term for project understanding and helps to gain the project information.

2.2 Introduction of Ergonomic

2.2.1 Historical of ergonomic

In the 5th century BCE ergonomic principles was used in the design of their tools, jobs, and workplaces. One outstanding example of this can be found in the description. Marmaras et al. (1999) state Hippocrates gave of how a surgeon's workplace should be designed. Later in the 19th century Frederick Winslow Taylor pioneered the "Scientific Management" method, which approach to improve efficiency by eliminating unnecessary steps and actions.

World War II marked the development of new and complex machines and weaponry, and these made new demands on operators' cognition. The decision-making, attention,
situational awareness and hand-eye coordination of the machine's operator became the key success of a task (human error).

Ergonomics today is growing and changing. The discipline’s development stems from increasing and improving knowledge about the human and is driven by new application and new technological development.

Kroemer et al. (2001) mention, several classic sciences provide fundamental knowledge about human beings. The anthropological basic of such knowledge consist of anatomy, describing the build of the human body; orthopedics, concerned with the skeletal system; physiology, dealing with the functions and activities of the living body, including the physical and chemical processes involved; medicine, concerned with illnesses and their prevention and healing; psychology, the science of mind and behavior; and sociology, concerned with the development, structure interaction and behavior of individual or group.

![Figure 2-1: Origin, development and application of ergonomic](Kroemer et al. 2001).
The development from basic sciences to applied discipline in ergonomic and the used of ergonomic knowledge in specific areas are depicted schematically (Figure 2-1). As more knowledge about human becomes available, as new opportunities develop to make use of human capabilities in modern system and need arise for protecting the person from outside events, ergonomic changes and develops.

2.2.2 Definition of ergonomics

Ergonomic is application of scientific principles, method and data drawn from a variety of discipline to the development of engineering systems in which people play a significant role. Among the basic disciplines are psychology, cognitive science, physiology, biomechanics, applied physical anthropometric and industrial systems engineering. Karl Kroemer Elbert et al. (2001) classify the engineering systems to be developed range from the use of a simple tool by a consumer to a multiperson sociotechnical system.

The International Ergonomics Association definition, ergonomics is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance (Karwowski, 2006).

Besides, ergonomics is also the science of making things comfy. It makes things efficient. Thus, the practitioner of ergonomics so called ergonomists studies how work is done and how to work better. It is the attempt to make work better that ergonomics becomes so useful. And that is also where making things comfortable and efficient comes into play. Ergonomics is commonly thought of in terms of products. But it can be equally useful in the design of services or processes. It is used in design in many complex ways. However, it also helps to define problem solving and it makes things comfy and efficient.
Moreover, the ergonomic approach to design may be summarized in the principle of user-centered design. It was shown in Figure 2-2 in which if an object, a system or an environment is intended for human use, then its design should be based upon the physical and mental characteristic of its human users (S. Pheasant and C.M. Haslegrave, 2006).

Figure 2-2: The cycle of user-centered design
(S. Pheasant and C.M. Haslegrave, 2006)