

**UNIVERSITI MALAYSIA PAHANG
BORANG PENGESAHAN TESIS**

JUDUL: DESIGN OF AN ERGONOMIC COMPUTER MOUSE BASED ON A CASE STUDY ABOUT MUSCULOSKELETAL DISORDER (MSD)

SESI PENGAJIAN: 2007/2008

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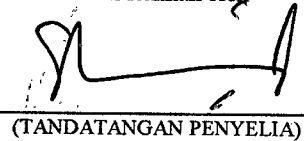
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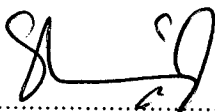
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ABSTRACT

Musculoskeletal disorder (MSD) is a new type of disease currently spreading among workers in Malaysia. Nowadays, the important of the research on this disease is to preserve the standard quality of human resource and technology in this modern and competitive world. We did not even realize that a computer mouse actually can trigger this disease that will make we suffer a lot of pain throughout the whole body in our old days. For the first step, the literature on MSD and the distribution of the questionnaires to respondents is important in designing an ergonomic computer mouse based on their needs. After the design being presented, simulation using CosmosXpress and CosmosMoldFlowXpress software is conducted in order to give a better understanding about the study.

ABSTRAK

Musculoskeletal disorder (MSD) adalah sejenis penyakit baru yang sedang menular di kalangan pekerja-pekerja di Malaysia. Pada zaman sekarang, kepentingan kajian tentang penyakit ini adalah untuk memelihara tahap kualiti tenaga kerja dan teknologi di dalam dunia moden dan kompetitif masakini. Ramai diantara kita tidak menyedari bahawa sebuah tetikus komputer sebenarnya boleh mencetuskan penyakit ini yang akan menyebabkan kita merasakan kesakitan di seluruh anggota badan sewaktu usia tua nanti. Untuk langkah yang pertama, penyelidikan tentang MSD dan edaran borang kaji selidik kepada responden adalah penting dalam merekabentuk sebuah tetikus komputer yang ergonomic berdasarkan kehendak mereka. Setelah rekabentuk ini dapat ditunjukkan, simulasi menggunakan program CosmosXpress dan CosmosMoldFlowXpress akan dijalankan untuk memberikan fahaman lanjut tentang kajian ini.

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LIST OF ABBREVIATIONS

MSD	-	Musculoskeletal Disorder
SPSS	-	Statistical Package for Social Sciences
UMP		Universiti Malaysia Pahang

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CHAPTER 1

INTRODUCTION

1.1 Project Background

In industry, many accident and injuries occur every day in a single year. Instead, most of the workers in this area are aware of the safety and regulation in their workplace. Many people do not realize that a simple application such as computer mouse may cause a disease that make people suffer a lot in their old days. It is already become a burden to our industry as it cost a lot due to the compensation because of early retirement and sick absence.

Musculoskeletal disorders, which are often soft-tissue injuries, occur when there is a mismatch between the physical requirements of the job and the physical capacity of the human body. Musculoskeletal Disorders (MSD) can range from general aches and pains to more serious problems. Medical practitioners do recommend that all the users who use computers regularly should report signs and symptoms as early as possible to prevent serious injury or permanent damage.

Thus, this study hypothesizes to find the association between the disease and computer mouse user in a local university in Malaysia. This study investigates the physical and psychophysical factors that could trigger the disease. The subject focused on computer mouse users who are the most risky population in the manufacturing field.

Specifically, this research is going to prove whether the hypothesis is right or wrong and to guarantee productivity and the prevention of the disease. Then, an ergonomic computer mouse will be designed based on the study on MSD then being run through computer test simulation to define its characteristics and abilities.

1.2 Project Objectives

The main objective of this final project is to study about Musculoskeletal Disorders (MSD) among computer mouse users in Universiti Malaysia Pahang (UMP). Hence, other objectives are:

- i. To design an ergonomic mouse based on the data collected from the questionnaires.
- ii. To improve the ergonomic features on current computer mouse by turning the design into a prototype.

1.3 Project Scope

There are a lot of factors associated with MSD but this research will specifically focus on computer mouse user. Regarding to this, questionnaires will be distributed to respondents in UMP and divided among worker based on their faculties. Then, the data collected from the questionnaires will be analyzed using Statistical Package for Social Sciences (SPSS) software and designed using Solidwork 2007 software. Simulation of the design will be conducted using CosmosXpress and CosmosMoldFlowXpress software.

1.4 Project Assumptions

The use of questionnaires is based on certain assumptions:

- i. Those individuals will have had common understanding of MSD and familiar with the usage of computer and its application.
- ii. This understanding and these beliefs are shared and can be clearly expressed and quantified.
- iii. The perception of the respondents is representative of their organization.
- iv. The respondents are answering the questionnaire based on their daily routine.

1.5 Problem Definition

Nowadays, the usage of computer is widely used in our society and most of them are well educated of the application of computer. Manufacturing company are related to computer based technology and research shows that computer users with a long daily duration of computer use and mouse use experienced more musculoskeletal disorder symptoms than those with a short duration of computer use. Computer work in general seemed characterized by repetitive movements, which may be risk factor for musculoskeletal disorder.

MSD remain the common cause of disability among ageing population and there might be high possibility that this disease will occur among young people too. Therefore, there will be a significant relationship between this disease and performance of workforce in our country. This study will evaluate the effects of MSD among respondents in UMP, especially for computer mouse user.

However, we people in Malaysia might not aware of this disease and some of us didn't even hear about it. In addition to, there were very limited journals or articles about this disease that occurs among citizens in our nation. Therefore, we must ensure that most of people in Malaysia must have a wide knowledge about this disease and conduct a through study about it.

1.6 Thesis Organization

There are 5 chapters in this thesis and was organized as followed.

Chapter 1 - Introduction to Musculoskeletal Disorder (MSD)

A brief explanation about this study was included in this part of study. In addition to, it contains the objectives of the study, scope of the study, assumptions, problem definition and finally thesis organization.

Chapter 2 - Literature Review

Every single thing about MSD has been studied by taking previous research of this disease via books or journal into consideration. It is also an important task to compare the previous researches that have been done and find the relationship from those journals base on the scope given. Furthermore, this chapter also discusses the relationship of the disease with the usage of computer mouse. The history of computer mouse manufacturing process and its material have been studied in order to consider the new design of ergonomic computer mouse. Conceptual framework proposed for this study also been presented in this chapter.

Chapter 3 – Research Methodology

In this chapter, the arrangement of research design, sampling design, data collection method, survey instruments, assessment of measurement and statistical analysis have been included to be used for the requirement of the project. Justification for each questionnaire also been included in this chapter.

Chapter 4 – Data Analysis and Findings for Questionnaire

On the other hand, this chapter discusses the data collected from the questionnaire including the analysis of respondent's background, health condition, computer usage and mouse usage. An ergonomic mouse will be designed based on the data collected from the questionnaire and it also has the features that eliminating the factors causing the Musculoskeletal Disorder (MSD) disease.

Chapter 5 – Discussions and Conclusions

From the data, we can come up with discussions about MSD and newly designed ergonomic mouse. Any assumptions and error may be included to consider any unexpected result that may occur without notice. The theoretical and practical contribution of this study also will be stated in this chapter. Moreover, the recommendation for future research also been urged in order to improve this study. At last, a conclusion of the thesis will summarize the whole thing about this study.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The purpose of literature study is to navigate it and make comparison with the previous research that has been done. Thus, this chapter also will discuss the overall literature on the ergonomic study of computer mouse aspects. The research instrument form books, journals websites will be reviewed to build the basic of designing.

2.2 Musculoskeletal Disorder (MSD)

According to Daniela Colombini and Enrico Occhipinti, Musculoskeletal disorders (MSD) are the most common form of occupational disease. They are generating a growing population of workers with reduced working capacity.

The following statement about the types of MSD was adapted from a website (1) and shown as below:

- i. Repetitive Stain Injury
- ii. Carpal Tunnel Syndrome

2.2.5 Previous Study

Many books and journal about MSD and the research about it have been done continuously until this day. Based on Chris Jensen et.al (2003) journal, the study of the duration of computer work was positively associated with symptoms in the neck and shoulder for women but for hand or wrist symptom there was an association for men only. Thus, the duration of computer use appears critical for MSD symptoms but an increase in shoulder and hand or wrist symptom may be due to intensive mouse use.

Based on Chris Jensen et al., (2004), computer users with long daily duration of computer use and mouse use experienced more musculoskeletal disorder (MSD) symptoms than those with a short duration of computer use. Even though there are many literatures as above, the instrument used for the empirical analysis of the framework of this research were adopted from Chris Jensen et al., (2002). This is due to several reasons as follows:

- i. The instrument used allowed for multiple respondents for each question thereby providing greater reliability to the data.
- ii. The instrument used for each construct fit well with the symptoms of musculoskeletal disorder (MSD) from the previous literature and therefore have a high degree of content validity.
- iii. The instrument uses data from the world class manufacturing study and many the constructs were used and tested in the previous studies.
- iv. The instrument used is focused on the short term element, which is similar to the research's time horizon.
- v. The instrument used for each item makes a homogenous scale representing a single construct.

Table 2.1 Findings on MSD

No	Field	Journal	Author	Year	Research
1.	Medical	Medicine 34:9	Ian D. Griffiths	2006	This disease is the greatest cause of physical disability of ageing population. The percent among this population may increase to 30% by 2030.
2.		Sound And Vibration	Mats Hagberg, Lage Burstrom, Anna Ekman	2006	The association between whole body vibration exposure and musculoskeletal disorder in the Swedish work force is confounded by lifting and posture
3.	Engineering	AEP Vol. 15, No. 8	PC Wang, B Ritz, D Rempel	2005	It's a research to examine the association between work organization and the risk of MSD for sewing machine operators. The results is the pain cause more often to the workers by factors of age, gender and ethnicity
4.		International Congress Series 1924	Eva Schonstein	2006	64% of workplace injuries cause by musculoskeletal disorder. External factors such as magnitude, duration and frequency of loads influence workers responses. Internal factors such as age, gender or general health. Major consequences of this disease is sickness absence
5.		Industrial Ergonomics	Patrick G. Dempsey	2007	The effectiveness of ergonomics intervention to prevent MSD

2.3 Computer Mouse

From a website address (2), the following statement is about computer mouse including its definition, history, raw materials and relationship with MSD.

2.3.1 Computer Mouse: Definition

The computer mouse is an accessory to the personal computer that has become an essential part of operation of the computer. The small device fits neatly in the curve of the user's hand and enables the user, through very limited movements of the hand and fingers to "point and click" instructions to the computer. A rolling ball on the underside of the mouse gives directions on where to move to the cursor (pointer) on the monitor or screen, and one to three buttons (depending on design) allow the user to say yes by clicking the buttons on the right instruction for the computer's next operation.

2.3.2 Computer Mouse: History

Dr. Douglas Engelbart, a professor with the Stanford Research Institute in Menlo Park, California, developed the first device that came to be known as the mouse in 1964. At that time, the arrow keys on the keyboard were the only way of moving the cursor around on a computer screen, and the keys were inefficient and awkward. Dr. Engelbart made a small, brick-like mechanism with one button on top and two wheels on the underside. The two wheels detected horizontal and vertical movement, and the unit was somewhat difficult to maneuver. The unit was linked to the computer by a cable so the motion signals could be electrically transmitted to the computer for viewing on the monitor. One of Dr. Engelbart's co-workers thought the device with its long cable tail looked something like a mouse, and the name stuck.

2.3.3 Computer Mouse: Raw Material

The mouse's outer shell and most of its internal mechanical parts, including the shafts and spoked wheels, are made of acrylonitrile butadiene styrene (ABS) plastic that is injection-molded. The ball is metal that is coated in rubber; it is made by a specialty supplier. The electrical micro-switches (made of plastic and metal) are also off-the-shelf items supplied by subcontractors although mouse designers can specify force requirements for the switches to make them easier or firmer to click. Integrated circuits or chips can be standard items, although each manufacturer may have proprietary chips made for use in its complete line of products. Electrical cables and overmolds (end connectors) are also supplied by outside sources. The printed circuit board (PCB) on which the electrical and mechanical components are mounted is custom-made to suit the mouse design. It is a flat, resin-coated sheet. Electrical resistors, capacitors, oscillators, integrated circuits (ICs), and other components are made of various types of metal, plastic, and silicon.

2.3.4 Computer Mouse and MSD

The computer mouse is the most commonly used input device other than keyboard. Contemporary software packages including the popular Windows for word processing, demand increased mouse use than previously. Few systematic ergonomic studies of mouse use or its relationship to MSD symptom have been reported (Fogelman and Bragmus, 1999; Hamilton, 1996).

MSD in the neck and shoulder region are common in the general population (Hagberg, 1981). This disorders are the major cause of disability in people of working age and result in substantial personal and economic cost to the community (Herberts, 1980).

Report on shoulder and arm discomfort related to mouse use are common but the prevalence of musculoskeletal disorder and symptom have not been well documented in mouse users (Fogelman and Bragmus, 1999). (Pascarelli and Kella, 1993) stated that the mouse use is more prone to cause injury than the keyboard. However, data supporting the causing link between computer mouse and injury is lacking.

The dimension and arrangement of workstation appear to have an important influence on device placement and user's posture. With regard to mouse position, there is evidence that placing it near to neutral posture is preferable (Karlqvist et al., 1996). The position of mouse away from the midline body results in user working with the arms unsupported, the shoulder abducted and externally rotated and the arm in forward flexion (Franzblau et al., 1993; Cook and Kothiyal, 1994; Cooper and Straker, 1998; Fernstrom and Ericson, 1997).

Several studies have documented a relationship between upper extremity pain and the periods of time an operator use a mouse (Hagberg 1995; Karlqvist et al., 1994, 1996; Punnet and Bergqvist, 1997; Harvey and Peper 1997). (Karlqvist et al., 1996) found that more than 5.6 hour of mouse usage per week increased risk on shoulder symptom. In addition, a number of studies suggest that musculoskeletal disorder (MSD) may originate from both button clicking and use the fingers to grip a device.