

ERGONOMICS WORKPLACE DESIGN IN ASSEMBLY FOR PERSONS WITH  
DISABILITIES

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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DISABILITIES**

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**A report submitted  
in fulfillment of the requirements for the degree of  
Bachelor of Mechanical Engineering with Honours**

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**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

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## DECLARATION

I declare that this project report entitled “Ergonomic Workplace Design in Assembly for Persons with Disabilities” is the result of my own work except as cited in the references.

Signature : .....

Student's Name : .....

Date : .....

## APPROVAL

I hereby declare that I have read this project report and in my opinion this report is sufficient in terms of scope and quality for the award of the Bachelor of Mechanical Engineering with Honours.

Signature : .....

Supervisor's Name : .....

Date : .....

## **DEDICATION**

Dedicated to my beloved father and mother,

my friends and family members,

for their encouragement and supports throughout the project.

## ABSTRACT

This report describes an ergonomics approaches to the workplace design in assembly for the use of people with disabilities. The goal of this project is to design ergonomics workplace in assembly electronic devices for persons with disabilities whom experienced leg amputees. Low ergonomics design leads to serious physical difficulties, awkward positions, easily to feel fatigue and decrease the productivity of workers. Survey is conducted to obtain data and more detail information about project. Then, conceptual designs and final design which is the best design that fulfill the target requirement have been choose among them. For the analysis, ergonomics analysis is carried out on the details drawing of existing and new designs. The movement and posture used by people with disabilities while performing the assembly task have been analyzed by using CATIA V5R20 software. The comparison between existing and new designs have been made to get the better results of ergonomics. As the ergonomic analysis results in assembly task position, new designs which is simple movement and medium movement designs show the same final score of 3 out of 7 while existing design shows final score of 4 out of 7. Practicing good ergonomics give a chance to people with disabilities having a suitable job at their conditions plus it can achieves increase in productivity, improved health and safety of workers.

## **ABSTRAK**

*Laporan ini menerangkan pendekatan reka bentuk ergonomik di tempat kerja pemasangan untuk kegunaan orang kurang upaya (OKU). Matlamat projek ini adalah untuk mereka bentuk tempat kerja ergonomik dalam pemasangan alat elektronik untuk OKU yang mengalami amputasi kaki. Reka bentuk ergonomik yang rendah membawa kepada masalah fizikal yang serius, kedudukan janggal, mudah untuk merasa keletihan dan mengurangkan produktiviti pekerja. Tinjauan dijalankan untuk mendapatkan data dan maklumat yang lebih terperinci mengenai projek. Kemudian, reka bentuk konseptual dan reka bentuk akhir yang merupakan reka bentuk terbaik yang memenuhi keperluan sasaran telah dipilih di kalangan mereka. Untuk analisis, analisis ergonomik dijalankan pada butiran terperinci reka bentuk sedia ada dan baru. Pergerakan dan postur yang digunakan oleh OKU ketika melaksanakan tugas pemasangan telah dianalisis dengan menggunakan perisian CATIA V5R20. Perbandingan antara reka bentuk sedia ada dan baru telah dibuat untuk mendapatkan hasil ergonomik yang lebih baik. Oleh kerana analisis ergonomik menghasilkan kedudukan tugas pemasangan, reka bentuk baru yang mudah dan reka bentuk pergerakan sederhana menunjukkan skor akhir yang sama 3 dari 7 manakala reka bentuk yang sedia ada menunjukkan skor akhir 4 dari 7. Mengamalkan ergonomik yang baik memberi peluang kepada OKU mempunyai pekerjaan yang sesuai dengan syarat mereka ditambah pula dapat meningkatkan produktiviti, meningkatkan kesihatan dan keselamatan para pekerja.*

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## LIST OF ABBREVIATIONS

CAD	Computer-Aided Design
CATIA	Computer-Aided Three-Dimensional Interactive Application
MSDs	Musculoskeletal Disorders
CADWORK	Computer Aided Design of Workplace Assembly Layout
I4CP	Institute for Corporate Productivity
IDD	Intellectual and Developmental Disabilities
MCB	Miniature Circuit Breaker
RCCB	Residual Current Circuit Breaker
SOCISO	Social Security Organization
R&D	Research and Development
QFD	Quality Function Deployment
HOQ	House Of Quality
PDS	Product Design Specification
RULA	Rapid Upper Limb Assessment
PSM	<i>Projek Sarjana Muda</i>
JKM	<i>Jabatan Kebajikan Masyarakat</i>
OKU	<i>Orang Kelainan Upaya</i>

# CHAPTER 1

## INTRODUCTION

### 1.1 Background

Jastrzebowski (1857) established the word "ergonomics" as the natural laws of work. In other words, the science of human engineering is ergonomics. It involves designing a job that fits physically, prevents injuries and conditions and enhances comfort and productivity.

Ramazzini (1633-1714), an Italian physician, demonstrates a systematic connection between employment, pathology and occupational health. The effects of unpleasant working conditions on the workforce were not only asthma and tuberculosis triggered by fine particles but also metal mining employee diseases. It can claim that the relationship between health and work must be clarified during the industrialization era promoted by the Industrial Revolution that started in the 18th century.

Józefa Joteyko (1919) stated in his book that Measurements and values of labor fatigue in labor management science have been detailed.

In the study of ergonomics, we can identify specific tasks and motions that cause physical pain and injury and how to prevent such problems positions and movements. Good ergonomics adapt the job accordingly, instead of forcing the person to fit the job. It

should be designed to fit an individual's skill and limitations in an ergonomic workplace to allow people to do their jobs without being injured.

Tanaka (1921) introduced human engineering to Japan which was focused in American psychology and highlighted techniques that use human power most economically, contrary to labor science.

In the working environment, ergonomically designed furniture is important to maintain good body positions that keep the worker in the most natural and neutral positions. Ergonomically designed in workplace is very important to increase comfort and productivity.

Albrecht, G., et al. (2001), In the book of Disability Studies published by them, disability can be defined as a condition of the physical, mental, cognitive or development that affects the capacity of a person to engage in specific tasks or actions or to engage in typical daily activities or interactions. Most of the workers nowadays involve with disabilities and they need to become more independent with their works to reduce the illness. Good health is important for a community to work and participate.

Pecoraro, R., et al. (1989) describes the pathway to diabetic limb amputation. Some people who are disabled are amputees, meaning a person who is cut off in the arm or leg. The most common amputation is the amputation of the leg. Amputation is possible if the flow of the arteries, called peripheral arterial conditions, is poor because of damage or restriction. Body cells will not receive oxygen and nutrients from the bloodstream without a good blood flow. This leads to the beginning of death and infection in the affected tissue.

National Limb Loss Information Center (2005) conclude that about 1.7 million people are living with limb loss due to numerous factors in the United States. It is therefore estimated that an amputation has taken place in every 200 people in the United States. The

most common reasons for amputation consist of vascular complications (mostly diabetes), cancer and trauma. But many of them managed to overcome their loss or lack of a limb and recovered function and positive perspectives. Because of their disability, most have a difficult life. However, with a disability they do not have a great job. There are many types of job that give opportunities to them to join our society. As we know the jobs provided are not fully fill their interest but suitable with their condition and fit the requirement of a given position. For example, they work as an accountant to organize and prepare the financial statements of a company, to analyze costs and to conduct internal audits. Although managerial skills are the most necessary jobs, they can still fit the job.

## **1.2 Objectives**

1. To design an ergonomics workplace in assembly electronic devices for persons with disabilities whom experienced leg amputees.
2. To do ergonomics analysis of disabilities person associated with assembly work line.

## **1.3 Problem Statement**

A problem is an unsatisfactory situation that causes users difficulty. An effective ergonomic improve the process to identify the maximum work capacity and limit worker fatigue while improving efficiency and productivity.

Workers have to work more quickly and adapt to their unstructured workstation so that the demand for manufacturing products is high. Some tasks at assembly workstations require employees to be able to do their job for a long time. Ergonomics has been

considered a hot problem because it demonstrates the connection between certain injuries and people's way of working. We now realize that the human body can remain in unnatural or unusual positions for a long time by paying a price.

In terms of specific tasks and motions, study of ergonomic can lead us to identify the kind of positions, movements, and ways to prevent such problems that can cause physical pain and injury. Low ergonomics leads to serious physical difficulties and it will become more serious if involves person with disabilities. People with disabilities may be present form birth or occur during a person's lifetime such us ageing factor or accident.

As they prepare for their lives as an amputee, there are many questions. In order to achieve important goal which is the treatment from the rehabilitation process to restore their mobility, they have been through many things includes stabilizing the level of motivation and how well their prosthesis fits.

Organization and society should give these people opportunities to let them work and achieve their dreams because these dreams sometimes begin with the great job. Assembly workstation sounds suitable and great for them to work. Therefore, they need more ergonomically design workplace in assembly which is can reduce injuries during work. Furthermore, the workplace design should be achieving the standard of safety so that the users satisfied with the design and prevent unwilling accident happen while using the workplace design.

#### **1.4 Scope of Project**

1. To design an ergonomic workplace in assembly electronic devices for person with disabilities whom experienced leg amputees by using Computer-Aided Three-

Dimensional Interactive Application (CATIA), a software of Computer-Aided Design (CAD).

2. To analyze the movement and posture used by people whom experienced leg amputees while performing the assembly task.
3. The design fulfills the safety requirement including not harmful to the users, great endurance and environmentally friendly by applying initial analysis on design.
4. To perform ergonomics analysis on how disabilities person whom experienced leg amputees doing their assembly task at workplace that have been designed

## **1.5 General Methodology**

In this chapter, the method and procedure that are used to conduct this research project will be discussed. A brainstorming method is used to achieve the aim of this project. This method helps me to understand more the details about the topic given.

Flow chart and Gantt chart have been constructed to give a full view on project timeline and make myself easy to plan what to do efficiently and accurately. This method helps me to manage my time and finish the project perfectly.

Besides, literature reviews are studied. This method is applied by doing some research and evaluation which helps to find the excellent way to achieve the project goal and to ensure that the topic has been understood carefully. This method can be done by doing some research about articles on the internet and review by workers that performing the assembly work.

Survey is conducted to get data and information about the project. Two questionnaire's sections are provided which are one for people with disabilities whom

experienced leg amputees and another one for electronic devices manufacturing company. The aim of this survey is to get more details about what both desires for future job in assembly task that related to the objectives of the projects.

Next, conceptual designs were developed that related to the topic then final design which is the best design that fulfill the target requirement have been choose among them. Then detail design CAD software which is CATIA.

After that, ergonomic analysis is carried out using RULA. Analysis the movement and posture used by people with disabilities while performing the assembly task by using observation and suitable software.

## **1.6 Organization of Report**

Chapter 1 which is Introduction gives visual surfaces this project. The early stage of report is very important to let readers and peoples know the details about the projects. This chapter provides information about the background, identification of problem, objectives, scope and work flow of the project. Literature Review will be in Chapter 2, it will discuss about past research study that have been done before and it related to my projects. On Chapter 3, several methods to accomplish the project will be discussed. These methods such as planning, surveys, QFD, HOQ and PDS to gather information to run this project. In Chapter 4, conceptual design will be discussed. Detail drawing for existing and new designs will be developed for the analysis. Next, results and discussion which is ergonomic analysis for new and existing design will be discuss in Chapter 5. There will be a comparison of results between new and existing designs to get clear observation. Lastly, conclusion for overall project and recommendation will be discussed on Chapter 6.