
# UNIVERSITI TEKNIKAL MALAYSIA MELAKA

## ERGONOMIC DESIGN APPROACH TO ENHANCE THE LABOR PRODUCTIVITY IN MANUFACTURING

**This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Management)(Hons.)**

**by**

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**2015**

# UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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SESI PENGAJIAN: **2014/2015 Semester 2**

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I hereby, declared this report entitled "Ergonomic Design Approach To Enhance The Labor Productivity in Manufacturing" is the results of my own research except as cited in references.

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Author's Name : ELIYANA SARI BINTI SUMAIDY

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# APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Management) (Hons.). The member of the supervisory is as follow:

……

(Project Supervisor)

DR. SERI RAHAYU BINTI KAMAT

# ABSTRACT

This project has been conducted in CTRM Aero Composites Sdn. Bhd. located in Batu Berendam. According to research observation, interview and distributing questionnaires, the problem statement was focused on low back pain occurred when workers work with awkward postures and the impact on workers productivity. Therefore the aims for this project were determined the ergonomic design problems in workstations, analyze the body posture and worker productivity and suggest the best ergonomic design solutions to improve the body posture and worker productivity. In order to analyze the body postures, the anthropometry measurement, workstation measurement, work measurement and labor productivity is collected. The CATIA V5 is used for RULA analysis before and after improvement. The new suggestion on ergonomic design is to reduce the bad postures. The labor productivity is calculated before and after the improvement made to compare and validate the improvement of workers postures toward worker productivity. All the results from the analysis are compared after the bad postures are reduced. The scope was focused on the postures due to prolonged standing and sitting that affects the low back pain. The project is limited because there will no fabrication and the improvement of workers postures only by CATIA V5 to validate the effectiveness of the new postures. The expected results from the survey questionnaire we capable to identify the ergonomic design problem in workstation, able to find out the reasons behind the body posture and its effect on the worker productivity and reduce the problems by suggesting the suitable ergonomic design that will increase the worker productivity. As recommendation, this research could be further investigated through the implementation of proper tools to reduce low back pain problems in workers.

# ABSTRAK

Projek ini telah dijalankan di CTRM Aero Composite Sdn. Bhd, bertempat di Batu Berendam. Berdasarkan kajian pemerhatian, temu bual dan setelah mengedarkan soal selidik, pernyataan masalah telah difokuskan kepada sakit pinggang apabila pekerja bekerja dengan postur pelik dan memberi kesan kepada produktiviti pekerja. Maka, tujuan projek ini adalah menentukan masalah reka bentuk ergonomik di stesen kerja, analisis postur badan dan produktiviti pekerja dan mancadangkan penyelesaian reka bentuk ergonomik untuk bertambah baik postur badan dan produktiviti pekerja. Dalam usaha untuk menganalisis postur badan, data ukuran anthropometer, ukuran stesen kerja, ukuran kerja dan produktiviti pekerja telah diambil. CATIA V5 telah digunakan untuk menganalisis RULA sebelum dan selepas peningkatan. Cadangan baru reka bentuk ergonomic untuk mengurangkan postur yang salah. Produktiviti pekerja telah dikira sebelum dan selepas peningkatan dibuat untuk bandingkan dan mengesahkan peningkatan postur pekerja dan produktiviti pekerja. Semua hasil keputusan dari analisis telah dibandingkan selepas postur yang salah dikurangkan. Skop projek ini telah difokuskan kepada postur iaitu berdiri dan duduk yang lama telah memberi kesan kepada sakit pinggang. Projek ini terhad kerana tiada fabrikasi akan dilakukan dan peningkatan postur pekerja hanya melalui CATIA V5 untuk mengesahkan keberkesanan postur yang baru. Hasil jangkaan adalah dari tinjauan soal selidik, kami telah mengenal pasti masalah reka bentuk ergonomik di stesen kerja, punca pekerja bekerja dengan postur yang salah dan kesannya pada produktiviti pekerja serta mengurangkan masalah dengan mencadangkan kesesuaian reka benrtuk ergonomik yang akan meningkatkan produktiviti pekerja. Sebagai cadangan, kajian ini boleh dilanjutkan siasatannya melalui pelaksanaan alatan yang sesuai untuk mengurangkan masalah sakit pinggang pekerja.

# DEDICATION

In the name of Allah S.W.T, Most Gracious, Most Merciful.

Special big dedicated to my beloved parents, En Sumaidy bin Jangin and Pn Kiptiah binti Rejam, whose never stop giving me so much support and all the sacrificed that makes me who I am today. May Allah bless them always.

To my beloved family who is sincerely never tired to love, care and fulfill what I am whishing for.

To my respectable supervisor, Dr. Seri Rahayu binti Kamat, who never failed to guide, assist and giving advice in order to help me completes this final year project.

And lastly, my first priority is thanking all those who have so generously contributed and inspired me in my education's life. Special thanks to my entire lecturers, my fellow friends and those who have contributed in my four years studies at Universiti Teknikal Malaysia, Melaka (UTeM).

# ACKNOWLEDGEMENT

السلام عليكم ورحمة الله وبركاته بسم الله الرحمن الرحيم

Alhamdulillah, thank to the almighty Allah, my first and most heartily gratitude who blesses to all for his divine throughout my life and my final year project.

At this juncture, when I am submitting my final year project, I honestly feel that this report of study would not have been possible without the support guidance, critique and direction of those who are associated with my academic and personal life.

Foremost, I would like to extent my respect and gratitude to Dr. Seri Rahayu Kamat, my supervisor and academic adviser whose advises are very helpful for my report and her concern for the students has always made me perform better confidentially. Thanks for guiding me in a very well to finish my report.

I acknowledge my deep indebtedness to my family who always pray the best for me and understand on my journey to complete this report.

My special thanks to my senior who also master student of my supervisor that always had a time to teach me on using software CATIA V5 and advise me to perform well in this my final year project.

I deeply thanks to all my classmate friends that also under my supervisor and thanks to all my friends whom unforgettable support and motivation. Last but not least I thank to all my respondents and engineer in the company this project conducted without them this study can't be possible.

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| | | |
|---|---|---|
| CTRM | - | Composite Technology Research Malaysia |
| Sdn. Bhd. | - | Sendirian Berhad |
| CATIA | - | Computer Aided Three-dimensional Interactive Application |
| MSD | - | Musculoskeletal Disorder |
| CTD | - | Cumulative Trauma Disorder |
| WHO | - | World Health Organization |
| RULA | - | Rapid Upper Limb Assessment |
| LBP | - | Low Back Pain |
| STS | - | Sit to Stand |
| WRMSD | - | Work-related Musculoskeletal Disorder |
| CREEP | - | Continuous or Repetitive Elongation of the Elastic Properties of Tissues |
| USAPHC | - | U. S. Army Public Health Command Ergonomics Program |
| OSHA | - | Occupational Safety & Health Administration |
| Eq. | - | Equation |
| Min. | - | Minutes |
| METS | - | Metabolic Equivalents |

# CHAPTER 1
# INTRODUCTION

## 1.1 Introduction

In this chapter consist of background that describes the method uses, objectives, problem statement and scope of the project as well as the outline of the project. This chapter acts as the warming outcome for the reader to get more understanding on the topic of the project. Descriptive information is also given on the Ergonomic, Musculoskeletal Disorder (MSDs), Low Back Pain, Workstation design, Anthropometry Measurement and RULA Assessment.

## 1.2 Background

Ergonomic is one of the crucial part need to be considered while working in industries or companies. In maintaining while improving the productivity, all the aspects should be taken including ergonomic. Webster's New World Dictionary (College Edition) defines ergonomics as "The Study of the problems of people in adjusting to their environment; especially the science that seeks to adapt work or working conditions to suit the individual worker". Ergonomics may also be considered as the suitability of the person in their workstation design. The mismatch of workstation design and the physicality of

the workers may expose to the musculoskeletal disorders (MSDs). Ergonomics is solution in finding the best design of works in the workplace that suitable with workers. The implement of ergonomic design will reduce the risk of pain in muscles and cumulative trauma disorders (CTDs). Mostly workers will feel fatigue and discomfort due to the awkward postures in the workplace. Thus, their muscles, tendons, ligaments, nerves, and blood vessels can be damaged and those known as MSDs.

MSDs represent an extensive variety of scatters, which can vary in seriousness from gentle, intermittent indications to serious constant and crippling conditions. The rundown of cases are carpal tunnel syndrome, tenosynovitis, tension neck syndrome and low back pain.

MSDs are regularly mistaken for ergonomics. Ergonomics is the investigation of fitting working environment conditions and employment requests to the abilities of specialists. At the end of the day, MSDs are the issue and ergonomics is an answer. The work-related musculoskeletal disorders are known has a related with the prolonged standing. Thus, it will give the lower back pain to workers (Lafond, D. et al., 2009).

In this study, we concentrate on low back pain and the contributing factors are the awkward postures; prolonged standing and sitting and repetitive motions. Low back pain definition of the World Health Organization (WHO) is neither a disease, nor a diagnostic entity of any sort. The term refers to pain of variable duration in the area of lower back of body so often that it has become a paradigm of responses to external and internal stimuli, for example, “Oh, my aching back” is an expression used to mean that a person is troubled.

Prolonged standing may bring about weariness and uneasiness in the legs. The MSD can come about, for instance, terrible feet and other foot issues. In the mean time, delayed sitting obliges the muscles to hold the storage compartment, neck and shoulders in an altered position. This crushes the veins in the muscles, decreasing the blood supply. A lacking blood supply, quickens weakness and makes the muscles inclined to damage. Workstation design can have a huge effect on your general well being and prosperity. A

few issues have as of now been examined, yet there are a huge number of different distresses which can come about because of ergonomically mistaken machine workstation setups. For instance, poor seats and/or awful carriage can result in lower back strain; or a seat that is excessively high can result available for use misfortune in legs and feet. Workstation design is one of the major areas in which ergonomist can improve the fit between human, machine and the environment. The ergonomic workstation design considers the data of human anthropometry to improve workers' health and increase productivity. Through practical anthropometry measurement, the knowledge and skill of students regarding to human anthropometry and capabilities will be improved, while designing the workstation could enable to apply anthropometry data and show to them how different design of workstation will contribute to variability of workers' productivity.

According to the *Anthropometrics and Ergonomics* (2013), the definition of an anthropometry measurement is the study of the human body and its movement, often involving research into measurements relating to people. It also involves collecting statistics or measurements relevant to the human body, called Anthropometric Data.

RULA has been developed to provide a rapid of the load on the musculoskeletal system operators for position, muscle function and their powers impose. It is designed to evaluate the possible operators exposed to a known muscle loading members contribute to the disease. RULA meet their role as a method for screening a large some operator quickly, but the scoring system developed also an indicator of the level of loading experienced by individual body parts. RULA used without the need for any equipment and, after training in the use, has proven a reliable tool to be used by people whose job it is to carry out the work evaluation. It can be used as a screening tool or incorporated into a broader assessment and ergonomics of epidemiology, physical, mental, environmental and organizational factors. To provide a quick screening tool administered, detailed exempt from RULA methods and can be considered in further development. Most significantly, the evaluation of posture on the fingers and thumb is needed in a number of investigations where exposure to risk factors for the high digits. RULA does not

include such detail, although any force applied by finger or thumb is recorded as part of the evaluation procedure.

## 1.3 Problem Statement

This project has been conducted at CTRM Aero Composite Sdn. Bhd. Due to the company rights, there is some evidence are considered confidential. For example, worker's health record and pictures of workers posture while working. Thus, the real pictures will not be included in this report. In order to increase the workers productivity, the company should consider the aspect of ergonomic of the workers. Almost all the process is handled by a human instead of a machine or robot. Therefore, work with human need consideration on the rest allowance and the workstation design to cover the fatigue as it may affect the worker productivity. This is due to the awkward posture while process the panels. Some of the panels in some working area can work while sitting, but the others have to stand while doing work. The prolonged standing and the prolonged sitting will give bad effect to the human body.

It can be conclude that, this project focuses on lower back pain the operators faced because of the posture of prolonged standing and sitting of the workers while working. As the workers need to stand or sit in a day more than 4 hours, according to the work instructions to complete their works will affect the focuses of the workers. These long terms period affect the workers as the workers need to stay in repetitive posture or same posture. The repetitive posture in more than 4 hours will give result of low back pain. The data of anthropometric measurement and the RULA assessment need to be collected and calculate to propose the suitable workstation design needed by the operators in the company.

## 1.4 Objectives

Based from the problem statements states, it is necessary to come out with the clear and accurate solution regarding to the improved productivity.

1) To determine the ergonomic design problems in workstations.
2) To analyze the body posture and workers productivity.
3) To suggest the best ergonomic design solutions to improve the body posture and workers productivity.

## 1.5 Scope of Project

The important of this project is on the reducing the bad posture of workers by suggesting the best ergonomic design and the effect of the posture before and after improvement towards the worker's productivity. The reducing the bad posture will focus on the areas that have a higher risk of injuries and high potential risk level of low back pain. The working posture of the workers will be observed and identified to be analysis. Some risk factors to be studied are awkward postures. In this study, the aspects that will be look are ergonomic requirement, ergonomic principle and ergonomic problem faced by the user. Besides, other aspects such as anthropometric measurement, working posture, low back pain, RULA analysis and labor productivity also covered in this study. This study also focused on the relationship between the ergonomic interventions with labor productivity. CATIA software is used to simulate the design and to do RULA analysis to prove the improvement and effectiveness of the suggestion on the new posture. However, there has some limitation in this study because the CATIA V5 simulation will be carrying out to validate the effectiveness of the workstation as there is no fabrication and real implementation regarding to the improvement posture. The questionnaire is distributed among the workers to analyze the experience pain causes by the awkward posture and

improvement will do to reduce the pain. Through the improvement, the productivity of the labor will be enhanced as the workers work in suitable posture.

## 1.6 Project Outline

This study was divided into five chapters. The first chapter is describing about the introduction of the study. This including the overview of the project, objectives, scope of the study, problem statement and also the outline of the project.

The second chapter will describe about the literature reviews which focus on the past studies that relates to the title of this study. The references of this study are based from the books, journals, past research and website. This chapter also discussed about the method used to gain the information based from the researchers.

The next chapter, which is the third chapter, is discussing about methodology. This chapter describes on how the study is conduct using several tools that was divided into two phases in order to finish this study. Gantt chart will be developed according to the time provided to see whether this study is following the time or not. The questionnaire, anthropometric measurement, RULA analysis, workstation design, work measurement and labor productivity methods are used in order to collect data from the industry.

While for the chapter four, it express about the result and discussion. The result and analysis will determine whether the project achieves the objectives of the study. The existing ergonomic posture will improve in order to reduce lower back pain among the workers and improve the labor productivity. While the data collected, discussions are made to describe the entire result finding.

Lastly, the final chapter that is chapter five is discuss about the conclusion and future work of the study. This chapter includes the summary of the entire work, containing the problem statements, method used, and general results of the recommended approach to fulfill the objectives that was stated earlier.

# CHAPTER 2
# LITERATURE REVIEW

## 2.1 Introduction

In the first chapter of this study was described about the background that consists of objectives, problem statement and scope of the study. In this chapter mainly discussed about the references review. Generally, this chapter contains the literature review that based on the operation, principles and a mechanism. This related to lower back pain after work in a posture of prolonged standing and sitting affected by the workstation design that may reduce the productivity. Each source or information was selected based on the relation with the scope of the study.

## 2.2 Low Back Pain

Low back pain (LBP) is the feeling of pain and discomfort in the lower back. The critical painful of it will lead to common reasons people miss work. Low back pain is generally brought on when a ligament or muscle holding a vertebra in its legitimate position is strained. At the point when these muscles or ligaments get to be weak, the spine loses its dependability, resulting in pain. The nerves in our body are attached with all parts of body from the spinal cord. Hence, the back issues can prompt torment or