



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**THE HUMAN ANALYSIS AND ERGONOMICS FOR THE DRIVER SEAT DESIGN
OF A TRACTOR**

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

by

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DECLARATION

I hereby, declared this report entitled “The Human Analysis and Ergonomics for the Driver Seat Design of A tractor” is the result of my own research except as cited in references.

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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 Design) with Honours, The member of Supervisory committee is as follow:-

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ABSTRAK

Ergonomik adalah sains gunaan berkenaan dengan merancang dan mengatur perkara yang orang gunakan supaya manusia dan perkara-perkara tersebut berinteraksi dengan paling cekap dan selamat. Kerja yang berkaitan dengan gangguan muskuloskeletal adalah sekumpulan penyakit yang menyakitkan otot, tendon dan saraf. Pendedahan pekerja kepada faktor risiko gangguan otot akan meningkatkan risiko kecederaan pekerja. Ergonomik akan membantu dalam mengurangkan keletihan, meningkatkan produktiviti serta mengurangkan bilangan keterukan gangguan muskuloskeletal berkaitan dengan kerja.

Projek Tahun Akhir ini memberi tumpuan terutamanya kepada analisis manusia dan ergonomik untuk reka bentuk tempat duduk traktor.

Sebuah kerusi traktor diletakkan di dalam ruang yang terhad, yang apabila bergerak, mengalami daya dinamik, antaranya daya emparan, memainkan peranan yang penting untuk menyebabkan ketidakselesaan kepada pemandu. Walaupun jurutera boleh mereka bentuk kereta menjadi ergonomik mesra, ia tidak bermakna bahawa satu reka bentuk akan sesuai untuk semua pengguna, terutamanya jika kereta tersebut direka bentuk untuk seseorang dengan perkadaran tertentu. Kajian ini dijangka akan menerangkan dan memberikan pemahaman yang lebih baik tentang reka bentuk tempat duduk pemandu dalam traktor yang ergonomik. Berdasarkan data pengukuran antropometri dan prinsip-prinsip ergonomik, kerusi traktor boleh diperbaiki dengan menggunakan kaedah analisis RULA.

ABSTRACT

Ergonomic is an applied science concerned with designing and arranging things people use so that the people and things interact most efficiently and safely. Work-related musculoskeletal disorder is a group of painful disorders of muscles, tendons and nerves. Exposure of a worker to the risk factor of musculoskeletal disorders will increase the worker's risk of injury. Ergonomic will help in reducing fatigue, increase productivity as well as reduces the number of severity of work-related musculoskeletal disorders.

The Final Year Project mainly focus on the human analysis and ergonomics for the seat design of a tractor.

A tractor seat is placed in a limited space, which when in motion, undergoes dynamic forces, among which the centrifugal force, plays an important role to cause discomfort to the driver. While engineers may design cars to be ergonomically friendly, it doesn't mean that one design will work for all users, especially if the car is design for a person of certain proportions. This study is expected to explain and give better understanding about the ergonomic driver seat design of a tractor. The overall study benefit is to analyze the tractor seat and redesign the ergonomic tractor seat in order to prevent the musculoskeletal disorders. Based on the anthropometric measurement data and the ergonomics principles, the ergonomic of a tractor seat can be improved by using RULA analysis method.

DEDICATION

“Every challenging works needs self-efforts as well as guidance from elders especially those who were very close to our heart.”

My humble effort I dedicate to my sweet and loving

Mother (Halimah Bte Wan) & Sister (Suhaily binti Abdul Hamid)

Whose affection, love, encouragement and prays of days & night make me able to do my best in my Final Year Project

Along with my hardworking and respected supervisor,

En Abd Halim Hakim bin Abd Aziz

For supporting and guiding me efficiently through the completion of my Final Year Project.

And to all my beloved siblings and friends, thank you for the support and prayers. May ALLAH bless all of you!

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CHAPTER 1

INTRODUCTION

1.0 Introduction

For the first chapter of this report, there are several sub topics concluded which are the background of the project, objectives of the study, problem statement, scope and constraint in finishing this study, benefits of study, structure of project and also conclusion of chapter 1. The background of the study enlightens roughly the overall overview of the thesis topic and the information about the methodologies researched. The basic essential of the ergonomics and human analysis will be conversed in the background of study. Whereas the objectives of the study and the problem statement will explicates the matters that need to be addressed and describing what the study is trying to accomplish. After that, the scope and limitation of the study will briefly describes about the domains of the research and the occurrences that ascend in the study. This research is predominantly about the human analysis and ergonomic of driver seat design for an agricultural tractor.

1.1 Background of study

Referring to the approved meaning of the International Ergonomics Association (IEA), the ergonomics is the systematic discipline correlated with the knowledge of the connections amongst other elements of a system and human. The expressions of 'Ergonomics' and 'Human Factors' are consequently synonyms and can be used interchangeably. These expressions also bring up to 'the profession that relates theoretical philosophies, statistics and approaches to enterprise acceptable to boost human welfare and entire system performance'.

An ergonomist plays an important role to the preparation, strategy and assessment of chores, works, goods, societies, atmospheres and organizations in order to make them well-suited through the requirements, aptitudes and boundaries of society.

Ergonomics is a structures-oriented discipline, which can be useful to all features of human action. Ergonomists frequently labour in certain financial divisions or submission territories, which are not equally exclusive and change over time. Ergonomics is a discipline that can be functional to OSH to assist and guarantee that workplace hazards are prevented at the design phase, removed at a future step, or controlled and reduced if they cannot be abolished. It can hence expand the security, cosiness and well-being of employees. It also has larger effects by improving the protection of structures of work and for that reason, more generally, of the public as a whole.

In an ecosphere which bullocks are still used to cultivate the land, the present's contemporary agricultural tractor is an extremely sophisticated mechanism. The usage of the most recent technology in computers, hydraulics and electronics empower the agriculturalist to get bigger yield from the land.



Figure 1. 1: Tractor with hoe

Agricultural tractor driving comprises principally of two chores. The utmost essential of it is the observation and regulator of the mechanism devoted to the tractor. Most agricultural work is accomplished with the machine behind the tractor, calling for the driver to look towards the back for a huge amount of his period to execute his primary purpose. Tractor drivers are likewise estimated to work extended hours as rightness of procedures in farming is crucial. An investigation conceded out around 44 years ago (Gibbon, 1971) designated that roughly around 40% of a 1000 tractor's drivers questioned expected to occupy 9 hour or more driving on the day of the interview. Nearly 38% of the drivers also grumbled of back pain. Workers regularly whine of pains in the neck and shoulder, occasionally denoted to as 'tractor drivers' neck'. The problem of vertebral wounds (Rosegger and Rosegger, 1960) due to shakings and shock is possibly worse by the abnormal posture implemented.



Figure 1. 2: Agricultural tractor

1.2 Problem statement

The conversion towards increased accelerative speediness in farming presents innovative mechanical hitches associated with the contact of tractor drivers to extreme stages of whole-body vibration and lively actions throughout off-road and on-road conveyance and for the duration of field procedures.

Low-back pain is the indications knowingly linked as an intensified threat from the tractor driving. The incidence of low back ache in midst of the tractor drivers were initiate to be the supreme analytical occupational aspects from the supervisory for a number of possible confounders by awkward postures at work, total vibration dose and logistic modelling. Age and back accidents were also substantial pointers of low back pain. Perceived postural burden and vibration contact was detected of funded individually according to a multiplicative model to the additional risks for low-back illnesses. Based on the Quantitative regression investigation, a postural load has linear consequences on the increased risk for low back pain, whereas the possibility for whole body vibration exposure was comparative with a control of the probable vibration dosage. A European Directive's suggestion on

physical representatives suggested the whole body vibration exposure rank and it appear to be a lot tolerable to avert the continuing effects on the lower back apart from the exposure boundaries proposed by the International Standard ISO 2631/1. In order to expand the information of the prescription-effect connection in the middle of low-back difficulties and whole body vibration exposure amongst expert drivers, epidemiological data and additional exposure are desirable.

1.3 Objectives of study

The objectives of the study were formulated from the problem statement of the driver seat design of a tractor. The objectives were:

1. To study the existing design of the driver seat for the tractor.
2. To analyse the ergonomics design of the existing tractor's driver seat by using 3 type of measurement percentile of human modelling which are the 5th, 50th, and 95th percentile.
3. To propose the improvement design and redesign better seat for the driver's seat of the tractor.

1.4 Scope and limitation of study

The human analysis and ergonomics for the driver seat of a tractor were concentrated on this research. In this project, the features that might be discussed are the ergonomic problem faced by the users, ergonomic requirement and ergonomic principle. And similarly as the additional features such as working posture, time study, anthropometric measurement, RULA analysis, muscle fatigue and

musculoskeletal disorder (MMA) were as well enclosed in this project. But with the lack of a more absolute and the most rational standards mainly from biomechanical vantage point, the researchers remain of designing procedures and conditions to realize and comprehend the seat dynamics and assess the seating distress.

Numerous loads and burdens on the body were put by the amount of activities executed by the operator which were required for the work tasks on a tractor. Some of the instances of these hassles are front steering of tractor, control the machine and looking backward to observe, force were necessary to activate brake pedals and clutch, etc.

1.5 Benefits of study

This study brings a lot of advantage to everything specifically among the tractor's drivers and also the tractor's manufacturer. The benefits of this study are getting to categorize in what way the tractor seat can be change or design to supports the driver sense more comfortable when driving the tractor. Moreover, based on the ergonomic principles and anthropometric measurement data, the tractor driver seat can be enhanced consuming RULA analysis method. There is a complete profit of this study which are getting to consider the tractor seat and to enterprise the ergonomic driver seat for it to avert musculoskeletal disorder.

1.6 Structure of the project

This report will covers five chapters which are Introduction, Literature review, Methodology, Result and Discussion, and finally Conclusion and Future Work. The first chapter will enclose the introduction of project, and chapter 2 will concentrate

on the literature review. Literature review comprises of the previous study and research on the subject of the ergonomics for the seat of a driver. Meanwhile, chapter 3 will discuss roughly the technique and methodology for this project. The arrangement of research and technique of data collection will be conversed in this chapter. Chapter 4 will then analysed the data collected which the outcome and analysis will decide whether the project attain the objective of study. The current tractor seat might be remodel if necessary for it to advance and lessen musculoskeletal disorder amongst drivers. Then chapter 5 or the final chapter will review the entire study of this project development where it is accomplishing the objectives and also it will deliberate approximately the conclusion and future recommendation of the project. The process flow of the project are as shown in the Figure 1.3 below.

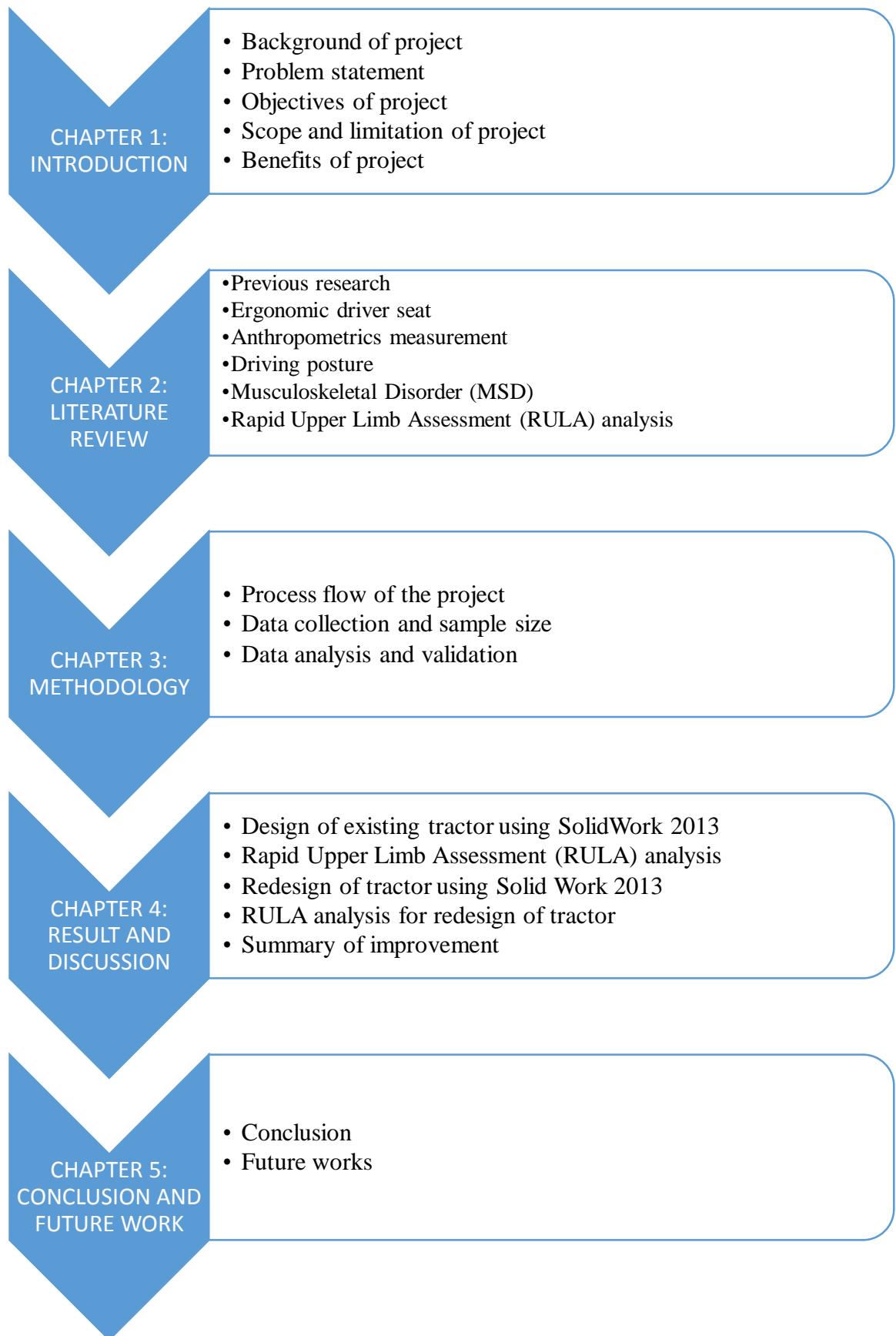


Figure 1. 3: Structure of the project

1.7 Conclusion

All the way through this part, the background of project, problem statement, objectives of the project, scope and limitation in completing this project, benefits of study and last but not least, the structure of project has been acknowledged. The purpose of an ergonomic seat is to afford not simply the appropriate function but to certify the more delicate yet all significant features of user comfort. People who are more comfy in their seat are more expected to be capable to sit and be productive for longer periods. Seat that do not offer effective support and adjustability can significantly escalate the spinal stresses resulting in uneasiness and increased injury risk. The encounter of designing for the human body is that it arises in a lot of different shapes and sizes. As an outcome, a design that might be comfortable for one person can be unsuitable for others. Apparently garments and shoes derived in different sizes to provide these differences. Appropriate fit comes to be much more vital when it communicates to a product that a person will be actually interacting with for hours at a time, for example, a tractor seat.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

In this chapter, the literature review of the thesis will be comprises in which associated to the scope and objectives of the project. The literature review deliberate roughly the RULA analysis, anthropometric measurement, musculoskeletal disorder (MSD) and ergonomic driver seat for the tractor. All the data and info were attained from articles, books and journals related to the project. To each foundations and data was carefully chosen constructed on the relative with the scope of the project.

2.1 Previous research

Kate LIVESEY, Lancelot BUTTERS (2012) has done an investigation about the ergonomics of tractor seat position. On their research, they conclude and shown that there is a relationship concerning the seat setting and the mental fatigue of the workers. The research has also showed definitively that seat position does affect the operator in terms of cosiness, and long and short term health condition defects. Because of the pain receptors in the brain this will undeniably affect the operator's presentation and condition. The operator will lose the ability to take part in simple

errands efficiently and this is because of the reason of mental stress and loss of concentration for many of hour after the process has ended. This connection that founded has been supported in other parts of the industry, where HGV drivers were tested for lower back pain in relation to seat positioning. It was found similar to this research that transient pain was discovered in the lower back when the seat was in a too close position. The investigation was effective in representing the need for more satisfactory seating positions within agricultural vehicles as it has been exposed that the population is shifting and thus call for advance seating specifications for the safe operation and procedure of all agricultural machinery.

The second previous study research has been conducted by C.R. Mehta, L.P. Gite, S.C. Pharade, J. Majumder, M.M. Pandey (2008). The study investigated on the “Review of anthropometric considerations for tractor seat design”. In this study, they showed that the anthropometric reflections need to be set due significance in determining seat measurements for the modifications of tractor seat design for worker’s cosiness. Anthropometric reflections have to also be specified due significance of determining seat measurements and the modifications for tractor seat design for operative’s cosiness. The anthropometric measurements, for example; sitting acromion height (5th percentile), intersected breadth (5th and 95th percentile), buttock popliteal length (5th percentile), hip breadth sitting (95th percentile) and popliteal height sitting (5th percentile) of agronomic labours ought to be engaged onto attention for design of seat backrest height, seat backrest width, seat pan length, seat pan width and seat height, correspondingly of a tractor.

A study on ‘Ride vibration on tractor-implement system’ has been conducted by C.R. Mehta, M. Shyam, Pratap Singh, R.N. Verma (2000). The outcomes shows indications of where the speeding up stages varied broadly as well as it were significantly reliant on variables which for example, the terrain conditions, type of operation and frontward speediness. Beneath most of the operational circumstances, as the advancing speed of travel amplified, the acceleration phases were amplified.