UNIVERSITI TEKNIKAL MALAYSIA MELAKA

TO ANALYSE THE WORKS BODY POSTURE IN PHN INDUSTRY SDN BHD USING RULA ASSESSMENT METHOD

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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ABSTRAK

Kajian projek ini telah dijalankan di salah sebuah kilang milik syarikat automotif pembuatan kereta. Terdapat pelbagai jenis pekerjaan yang melibatkan faktor peningkatan risiko ergonomik di setiap stesen kerja yang ada di dalam kilang tersebut. Jenis aktiviti pekerjaan yang paling berisiko adalah jenis aktiviti yang melibatkan pergerakan yang berulang dan mengangkat beban yang berat dalam postur yang janggal. Pekerja-pekerja di situ telah menunjukkan simptom-simptom yang mereka juga sedang menghadapi masalah berkaitan dengan gangguan muskulosketel. Penyataan masalah tersebut telah dinyatakan melalui pengagihan borang kaji selidik and temu ramah bersama pekerja-pekerja di stesen kerja terbabit. Selain itu, objektif kajian projek ini adalah untuk menyiasat mengenai postur badan pekerja berdasarkan reka bentuk yang sedia ada di stesen kerja setem, kejuruteraan die, dan kawasan kerja semula di PHN Industry Sdn Bhd, untuk mereka bentuk stesen kerja bagi meningkatkan keselesaan postur badan pekerja semasa bekerja dan meningkatkan prestasi kerja, dan akhir sekali mencadangkan postur tubuh badan semasa bekerja untuk mengurangkan masalah gangguan muskuloketel. Antara kaedah-kaedah yang telah dijalankan sepanjang kajian projek termasuklah pengagihan borang soal selidik, sesi temu ramah, pengambilan ukuran antropometri pekerja-pekerja, rakaman video, analisa postur badan menggunakan perisian CATIA V5, borang kaji selidik jenis Nordik, pengiraaan indeks aktiviti mengangkat barang NIOSH dan pengiraan penyaranan had limit berat beban yang diangkat. Oleh itu, skor RULA telah dapat dikurangkan pada akhir kajian projek melalui penambahbaikan postur badan pekerja semasa bekerja dan rekaan stesen kerja yang dicadangkan. Akhir sekali, kesedaran pekerja mengenai kepentingan untuk mereka bekerja dalam postur badan yang betul telah ditingkatkan.

ABSTRACT

The project has been done at a manufacturing industrial automotive factory. There are working activities that involve ergonomics risk factor in the workstations. The most ergonomics risk factor activities found in the workstations is repeating, heavy lifting activities and awkward working body posture. The workers are having signs of musculoskeletal disorder (MSD) problems. This problem statement had been highlighted through the distributed questionnaire and interview with the workers at workstations. Moreover, the objectives of this project are to analyse the body posture of the workers based on existing design of workstations in stamping, dies manufacturing, and rework area at PHN Industry Sdn Bhd, redesign the workstations in industry for improving the body posture and to improve the workers performance, and suggest the proper body posture to reduce the Musculoskeletal Disorder (MSD) problems. The methods had been used along this project include; interview session, questionnaire, CATIA V5 RULA analysis, NIOSH lifting index calculation, recommended work limit calculation, anthropometry body workers, video recording, and Nordic questionnaire. Then, the result that had been gained at the end of the study is decreasing of the RULA analysis score which can lead to musculoskeletal disorder problems through the improvised working posture and redesigned workstations. Besides, this project had been come out with the guidelines of recommended weight limit and lifting index that can be used by the workers and increase the awareness of the workers about the musculoskeletal disorder issues.

DEDICATION

To my beloved father, mother, family, friends, industrial training supervisor at PHN Industry Sdn Bhd, En Adnan Bin Abdul Kadir, and final year project supervisor, Dr Seri Rahayu Binti Kamat, thank you for all of the support and encouragement given throughout the process of completion of this project study.

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I am grateful to ALLAH SWT, by grace and blessing from Him, I had successfully completed my final year project, consisting final year project 1 and final year project 2 as required by the course that I studied which is Bachelor of Manufacturing Engineering (Manufacturing Management) in Universiti Teknikal Malaysia Melaka.

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Last but not least, a million of thanks to my beloved parents and siblings for the endless encouragement and support. I really need those to give me strength and inspiration to carry out this project to the best of my ability.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

UTeM	-	Universiti Teknikal Malaysia Melaka
MSD	-	Musculoskeletal Disorder
RULA	-	Rapid Upper Limb Assessment
OSHA	-	Occupational Safety and Health Administration
NIOSH	-	National Institute of Occupational Safety and Health
PPE	-	Personal Protective Equipment
PSM	-	Final Year Project
LI	-	Lifting Index
RWL	-	Recommended Work Limit
RSI	-	Repetitive Strain Injuries
WMSD	-	Work-Related Musculoskeletal Disorder
CTD	-	Cumulative Trauma Disorders
HSE	-	Health Safety and Environment
WCB	-	Workers' Compensation Board
ILO	-	International Labor Organization

CHAPTER 1
INTRODUCTION

This chapter describes the things about background study, problem statement of study, objectives of study, and scope and limitations of study. The benefits of study and structure of the structure had been retrieved from the scope and limitations of study. Through the study's objectives, the scope, as well as the limitation had been identified. The study is about ergonomic study on body posture in workstations.

1.1 Background of Study

The development of ergonomic just developed and recognized during the Second World War. This is because, for the first time human technology, and science are together applied systematically. Word ergonomic comes from the Greek Word meaning work law. Some countries used the terms human factors. The ergonomics aims to design appliances, technical system and tasks in such way as to improve the safety of human, health, comfort and performances. The main focus of this study is to analyse and design ergonomic workstation in industry. Hence, this study takes place at PHN Industry Sdn Bhd. According to the report issue by the PHN's engineers, the workstations at stamping machine line, assembly line, and receiving area had many problems regarding to ergonomics problems. The workers complain that they experience fatigue and pains at certain area of the body especially at the lower back of the body. These affect will lead to musculoskeletal disorder (MSDs). The MSD is very important to move the body part as it is made up of the soft tissue and bones in the human body. The damage of the tissue or the injuries of MSD will cause the workers to experience back pain that leads to MSD. When caused by the

hazard in the workplace, they are called work-related musculoskeletal disorder (WMSDs). Hence, the investigating and reducing the risks factor that can lead to MSD is a good approach to prevent acute and chronic MSDs.

MSD are conditions affecting which made up of the soft tissue and bones in the body and can present in the tendons, muscles, joints, blood vessels and/or nerves of the limbs and back. Musculoskeletal disorder is very important to move the parts. MSD also known as cumulative trauma disorders (CTDs) and repetitive strain injuries (RSIs).

Lei, Dempsey, Xu, Ge, and Liang et al, (2005) studied that MSD attributed to work include a group of conditions that involve the nerves, tendons, muscles, and supporting structures of the body such as intervertebral discs. Often attributed to or exacerbated by the work environment, these disorders are also referred to as work-related musculoskeletal disorders (WMSDs) which can cause symptoms such as pain, numbness, and tingling, as well as reduced worker productivity, lost time from work, temporary or permanent disability. These disorders lead to financial losses associated with workers' compensation insurance, or similar forms of social security in place.

The Workers' Compensation Board (WCB) of British Columbia defines MSD as:
"an injury or disorder of the muscles, tendons, ligaments, joints, nerves, blood vessels or related soft tissue including a sprain, strain and inflammation, that may be caused or aggravated by work". (Golob & Sykes, 2002).

1.2 Problem Statement

There are many automation industries had a problem regarding the design of the workstation. Most of the workstation has a bad design and indirectly affect the health and safety of the worker as well effect the productivity, accuracy and efficiency of the industry. The existing design of stamping, assembly and receiving workstations

have a limitation and disadvantages as it leads to ergonomics risks. In automation assembly industry, almost all the jobs are performed in standing position and this can lead to muscle fatigue.

Figure 1.1 shows the comfort level of body parts. The result shows the average comfort level of body parts from result questionnaire at stamping, die engineering, and rework area. The workers are tending to experience back pain while performed the stamping jobs that may takes to serious injuries known as Musculoskeletal Disorder (MSD). Musculoskeletal disorders (MSD) are also often caused by awkward postures, excessive force and repetition because of the limited work area, standing for prolonged period and heavy equipment. Furthermore, when performing the jobs tasks such as loading, lifting and reaching activity, the workers might feel the discomfort and pain in their arms and wrist. This study is expected to explain and give better understanding about the ergonomic workstation design for automotive industry.

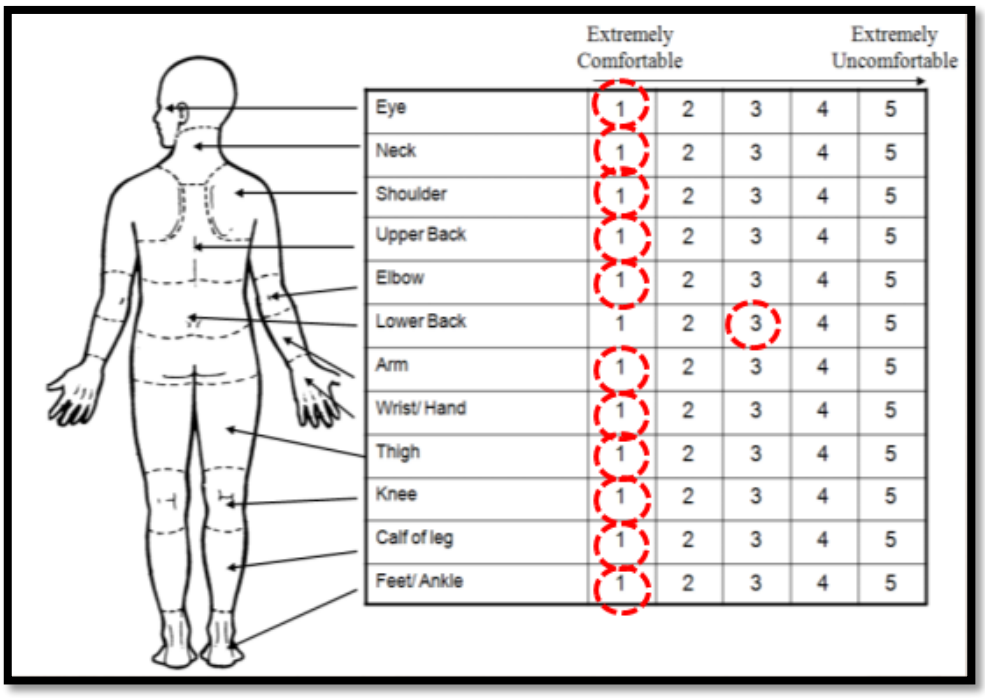

Figure 1.1: Comfort Level of Body Parts

1.3 Objectives of Study

Based on the problems arise related to the body posture, repetitive and manual lifting activities in the workstation, the objectives of the study are:

a) To analyse the body posture of the workers based on existing design of workstations in stamping, dies manufacturing, and rework area at PHN Industry Sdn Bhd.
b) To redesign the workstations in industry for improving the body posture and to improve the workers performance.
c) To suggest the proper body posture for reduce the Musculoskeletal Disorder (MSD) problems.

1.4 Scope and Limitations of Study

This study focused on reducing the bad effects involving ergonomic risk from repetitive, awkward posture, and manual lifting activities in PHN Industry Sdn Bhd. There are many loading and unloading activities occurred at the workstation. This study only focus on the activities that involved the most repetitive, awkward posture and manual lifting activities that causes risk problem to workers at the workstations. The data about the body posture of the effected worker had been retrieved. The musculoskeletal disorder problems of the workers had been retrieved by the distribution of questionnaires to the workers and RULA analysis methods. The working body posture of the workers had been reclaimed by taking the photos and videos of the workers while they are working. The ergonomics risk factors that had been studied include: awkward body posture, repetitive movement, manual lifting, contact stress and static posture. Besides that, other important things have been considered in this study are the requirement of the working activities, ergonomic obligation, ergonomic problems and ergonomic principles. In advance, other aspects such as NIOSH lifting equation, anthropometric measurement, muscle fatigue

musculoskeletal disorder (MSDs), and repetitive stress injuries (RSIs) had been enclosed in this study. The software that had been used to analyse the working body posture is CatiaV5. The working body posture analysis had been done to prove the effectiveness of the body posture improvement.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

As a key driver of Malaysia's economy, all industry strives in order to develop and encourage a steady growth in all aspect of human life. Leblebici, (2012) stated that performance of worker towards work is proportional with the compensation package of worker and this is mistaken by the business executives. An organization of industry will push workers to focus in their job much further. This is a dangerous issue which may bring onto ergonomics problem an organization of industry.

Knowledge and understanding on ergonomics should be accustoming towards occupational in industry as an ordinary things. Safety and health programs should be conduct intensively among workers to give a proper awareness about ergonomic problems.

A high percentage of report on musculoskeletal pain is a result of ergonomics problems. Mazza, (1997) stated that every year, the million workers suffering because of this kind of injury in industry activity. Some injury may cause consumption of money and time (Naeni, 2014). Therefore, activities that involving ergonomics problems have to be investigated analyze. The improper tool are used in industry are the main cause of musculoskeletal disorder among workers.

2.2 Ergonomics

There are many different definitions on ergonomics. Each person has their perception but all definition is related to each other. International Ergonomics Association (IEA), (2012) stated the ergonomic is the scientific discipline purposely design to optimize human well-being and overall systems performance related to knowledge of connection analysis between humans, machine, environment and other elements of a system. .

It is significant to understand variety of knowledge in ergonomics which include subject matter, influences and areas of application as a discipline and practice to analyze research on ergonomics (Cecilia, 2011). The important words for ergonomics is that 'health and safety' together with 'work design and organization' in order to gain sustainability and development of work system. (Genaidy, 2009, 2010; Bolis et al; 2014; Zink, 2014). Simply said, ergonomics is a science that works to make both worker and job appropriate in term of safety. Figure 2.1 shows the relationship of ergonomics.

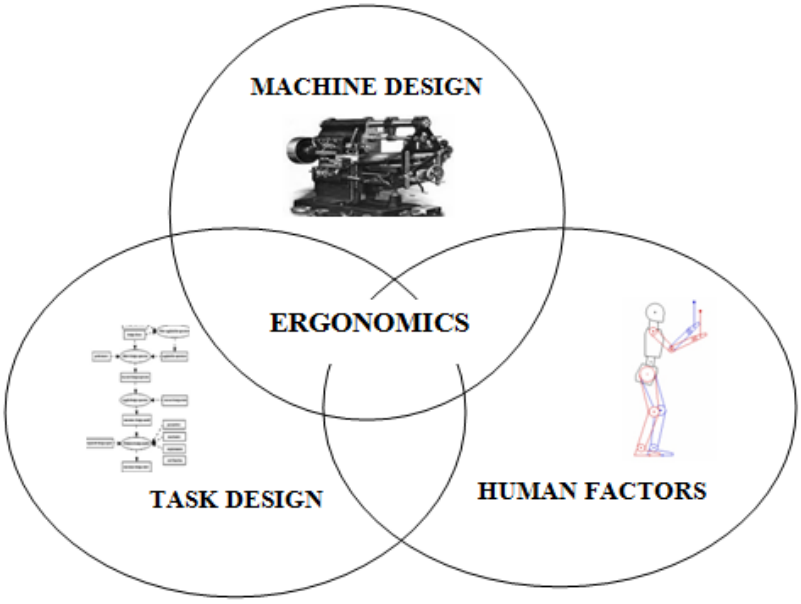

Figure 2.1: Ergonomics relationship (Cecilia, 2011).

2.2.1 Human Factor

Human factor is a comfort design and user friendly system that must have a functional term which considers the interaction of people with the object. It is the professions that optimize human well-being and overall system performance.

2.2.2 Machine Design

A machine design must have appropriate interaction with ergonomic practice by increase comfort, function and ensuring security or safety. Human performance when use the machine or product have be measured and identified (Carlos, 2009).

2.2.3 Task Design

Tasks must be designed in term of removing the overuse of tendons, muscles or another type of tissues. Exposure to risk factor should be eliminated such as workstation design of equipment and tools or material handling and lifting. Work must be change and organized such as managing the workload or speed of work. (United Steelworkers, 2002)

2.3 Body Mechanics

There are many approaches to obtain understanding on human body. Musculoskeletal system is a system that formed by bones, connection of bones and skeletal muscles that make sure human body can be move and support. Figure 2.2 shows the image of musculoskeletal system.

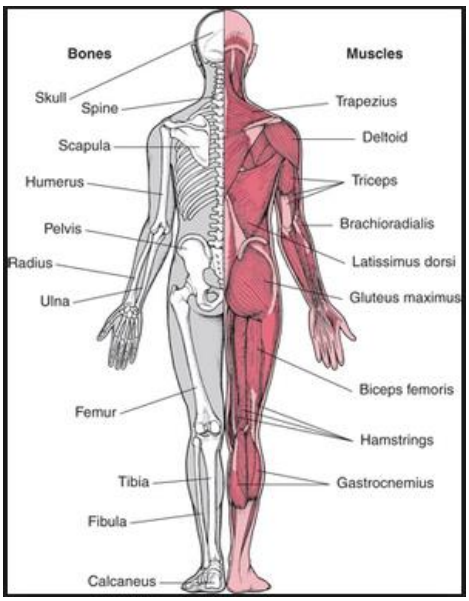

Figure 2.2: Musculoskeletal system

http://anatomy-medicine.com/

Chris, 2015 stated, understanding human body is quite tough because human system is complex in engineering, it become easier as body link is design to obtain understanding where human body links act as a system, making human body as stick man. He also described each links where:

- Arm (3 links): Upper arm, lower arm and the hand with joints at the shoulder, elbow and wrist
- Leg (3 links): Upper leg, the lower leg and the foot with joints at the hip, knee and ankle.
- Spine (3 links): Chest, lumbar and pelvis with links at the torso, waist and pelvis.

2.4 Posture

Posture can be defined as combination of all joints arrangement and position of body at any given moment (Anne, 2015). There are a few type of posture that being highlighted by engineering and biomedical course in world. Ideally, standing should be with knees slightly bent and shoulders slightly back. This position works with the

pelvis and lumbar, thoracic and cervical curves of your spine to achieve a vertical equilibrium.

Healthy posture: Natural positions that balance and support skeletal system's curves and weight-bearing abilities against the force of gravity

Static posture: When body not applying any motion which means the original position of bone and joints.

Ideal posture: When the alignment of joints is in the good state which means bones are not being pulled out of alignment by strain as it fits the original way of its position.

Kyphosis**:** Hunchback or unbalanced posture that can cause neck and back pain. The head is pushed forward, in front of your gravitational center while upper back is rounded, accentuating the thoracic curve.

Lordosis**:** Back posture that exaggerates the lumbar curve into a position often termed swayback that may create neck or back pain. Standing with locked knees contributes to this unhealthy posture that aligns the head behind your center of gravity. Shoulders may also be pulled back too tightly.

Scoliotic**:** Curvature is an abnormal sideways curve of the spine that results in improper alignment of the spine, shoulders and neck. Visible symptoms may include uneven shoulder height or a non-vertical neck angle.

2.5 Ergonomic Risk Factors

Risk can be divided into three categories which are low, medium and high respectively. A low risk still can be accept and thus reduction may not need but only control measures can be apply. A medium risk needs an approach or temporary

measure to control the risk while a high risk needs an immediate action. (DOSH, 2013)

Different ways of approach can control risks. Weinberg (2009) showed two methods to control risk which are elimination and substitution. Agwu (2012) suggest four ways which are administrative, isolation, personal protective equipment and engineering.

2.5.1 Workstation

Hary (2002) states that in order to offer the workers the finest man-machine boundary and the required adjustability with the aim to prevent discomfort and workplace injuries, a good ergonomic design principle must be practiced. An article named "Ergonomic: The backbone of a more productive warehouse" mentioned that workstation design can give big influence on the ergonomic health of the workers and the ergonomics workstation is all about the body posture. Body posture while working can be categorized to three types which are standing, sitting and both. The ability of the workstation's features such as length and the height to be adjusted so that its features are compatible to workers anthropometry measurement is very good ergonomics workstations.

2.5.2 Human Anthropometry

Anthropometric data is the data referred to a group of quantifiable physical dimensions and parts of the human body (BenAbdelkader & Yacoob ,2007). There are various fields involved with the use of anthropometric data since quite a long time then, such as forensics and physical anthropology. Nowadays, the anthropometrics data has been used within the areas of attire sizing and ergonomics workspace design instead of the others. Through the existence and growth of computer based image analysis, there are methods that can be used to estimate the human anthropometry from images that can be divided by two types of methods

which are; automated and semi-automated methods. The image-based anthropometric methods are contactless unlike the traditional anthropometric measurement which performs the measurements directly on the person. The image-based anthropometric method obtains the measurements by analyzing the images of the person. The method is fairly accurate and sample with the use of the high resolution of the images taken from multiple calibrated views.

2.5.2.1 RULA Assessment

Rapid Upper Limb Assessment (RULA) is an assessment that used to analyses the disclosure off workers to ergonomic risk related to upper extremity musculoskeletal disorder according to Middleworth (2007). The things that are mattered by the RULA ergonomic assessment tools are the postural load requirement and the biomechanical of job demand especially on the trunk, upper extremities and neck. The evaluation of the required body posture, repetition and force can be made by only single page worksheet. Both score for section A which is for the arm and wrist areas and for section B which is for the neck and truck are must be inserted in order to obtain the evaluation score. The tables on the form are then used after the data region is composed and scored with the intention of compiling the risk factor variables thus producing a single score that will presented the level of the musculoskeletal risk. RULA can be easily used without the needs for any advanced technology in ergonomics or any luxurious equipment. The RULA evaluator just has to fill in the score for the following body parts; wrist, neck, upper arm, lower arm, legs and trunk. The tables on the form as shown in Figure 2.3 will then be used to compile each risk factor variables after all the data had been assigned. Finally from the filled table, a single score the represents the level of the MSD can be generated. Table 2.1 shows the outline of the score level of the MSD risk.