



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**REDESIGN OF DRUM PACKING WORKSTATION AT
MEDIUM-SCALED ELECTRICAL CABLES
MANUFACTURER**

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

SYAFIQAH ATHIRAH BINTI ABDUL RAZAK

B050910120

900802145628

FACULTY OF MANUFACTURING ENGINEERING

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Signature :
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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:

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(Project Supervisor)

ABSTRAK

Pembuatan kabel elektrik merangkumi beberapa jenis proses iaitu melakar, melembar, merapat, menebat, amoring, membalut dan pembungkusan drum. Kajian ini memberi tumpuan kepada proses pembungkusan drum di kilang pembuatan kabel elektrik. Di stesen kerja sedia ada, pekerja perlu menjalankan proses pembungkusan drum. Situasi ini telah membuatkan pekerja mengalami sakit pinggang. Objektif kajian ini adalah untuk mengkaji pengalaman psikofizikal dan postur bekerja yang dialami oleh pekerja, mereka bentuk stesen kerja pembungkusan drum dengan mengambil kira maklumat daripada pekerja di lokasi kerja dan pihak pengurusan dan membuat simulasi cara kerja yang dilakukan oleh pekerja yang terlibat semasa melakukan proses pembungkusan drum di stesen kerja yang direka semula. Selain itu, kajian ini juga menggunakan soal selidik, Quality Function Deployment (QFD) dan Rapid Upper Limb Assessment (RULA) untuk menentukan keperluan pekerja, mereka bentuk semula stesen kerja dan menilai cara kerja di lokasi kerja. Kajian ini juga mendapati bahawa stesen kerja yang direka semula dapat memperbaiki postur bekerja yang dilalui pekerja melalui penurunan skor RULA yang telah dikurangkan daripada 7 kepada 3 untuk proses mengambil papan kayu. Berdasarkan keputusan perbandingan, kajian ini menyimpulkan bahawa stesen kerja yang direka semula mempunyai peningkatan yang ketara pada keadaan postur kerja. Untuk kajian dimasa hadapan, kajian ini mencadangkan bahawa pelaksanaan proses fabrikasi dan penggunaan di lokasi kerja yang sebenar dapat dilaksanakan di syarikat yang berkaitan.

ABSTRACT

Manufacturing of electrical cables require several processes such as drawing, stranding, laying-up, insulation, armouring, sheating and drum packing. This study focuses on the drum packing workstation in an electrical cable manufacturing company. In the existing workstation, the operators have to perform the drum packing process. This condition can contribute to low back pain to the operator. The objectives of this study are to assess psychophysical experience and working posture of operators, to redesign the drum packing workstation by considering information from the operators and the section leaders and to simulate the working posture of operators while performing drum packing process at the redesigned workstation. This study applied questionnaire survey, Quality Function Deployment (QFD) and Rapid Upper Limb Assessment (RULA) Analysis to determine the operators requirements, redesign the workstation and evaluate the working posture respectively. This study observed that the redesigned workstation able to improve working posture of the operator as the RULA score has reduced from 7 to 3 for the sub-process of picking wooden planks. Based on comparison results, this study concluded that the redesigned workstation proposed by this study has a significant improvement on working posture. For future work, this study suggests that fabrication and actual implementation of the redesigned workstation should be applied in the company.

DEDICATION

To my beloved parents, Encik Abdul Razak Bin Jidin and Puan Rozi Binti Othman, and the only sibling, Muhammad Taufiq Bin Abdul Razak, thank you for your supports for me to do my best on my Final Year Project. The motivation and encouragement inspired me to serve the best in my projects. To my Final Year Project Supervisor, Dr. Isa Bin Halim, thank you for guiding me to accomplish my project reports efficiently.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

CAD	-	Computer Aided Design
CATIA	-	Computer Aided Three Dimensional Interactive Application
CTD	-	Cumulative Trauma Disorders
HoQ	-	House of Quality
MSD _s	-	Musculoskeletal Disorders
NIOSH	-	National Occupational Safety and Health
OWAS	-	Ovako Working Posture Analyzing System
QFD	-	Quality Function Deployment
REBA	-	Rapid Entire Body Assessment
RULA	-	Rapid Upper Limb Assessment
SMEG	-	Surface ElectroMyoGraphy
SWOT	-	Strength, Weakness, Opportunity and Threat
VAS	-	Visual Analogue Scale

CHAPTER 1

INTRODUCTION

This chapter expose the background of the study. In addition, this chapter presents problem statements, objective of study, scope and limitation of study, significance of study and outline of the report.

1.1 Background of Study

The word *manufacture* first appeared in English in 1567 and is derived from the Latin *manu factus*, meaning “made by hand.” Manufacturing is concerned with making products. Examples of manufacturing process involve large press - to shape flat sheet metal into products, drilling for producing holes, and turning operation to produce cylindrical parts. Nowadays, there are many types of manufacturing industry which can be classified into three categories which are heavy manufacturing industry, light manufacturing industry and high-technology manufacturing industry. The manufacturing of cable can be grouped into heavy manufacturing industry.

Manufacturing of an electric cable, requires several processes. There are two types of cable that commonly produced in manufacturing industry which are power cable and telephone cable. Both cables are required to undergo several processes such as drawing, stranding, laying-up, insulation, armouring and sheating. Drawing is a cold

process where the wire rod passes through series of dies till the required diameter is obtained. Stranding is the process where the wires are laid concentrically and twisted to form the conductor. Besides, insulation is the process where the process of extruding the plastic material over the conductor. Moreover, laying-up is the process where the insulated cores are stranded together to form a cable. Furthermore, armouring is the process of stranding steel wires or lapping of tapes over the bedded cable and sheathing is the process of extruding the plastic material over the cable. After went through all the processes, the cable will be packed at drum packing workstation before sent to the customer. In the existing design of workstation, the operator has to perform drum packing process in awkward posture associated with bending. This condition may lead to discomfort and occupational injuries. Hence, the aim of this study is to redesign the drum packing workstation at medium- scaled electrical cable manufacturer. With the improvement in the workstation, so that it can provide safe working posture to the operator. The workstation will be redesigned through Quality Function Deployment (QFD).

1.2 Problem Statements

In the existing workstation design, the operator has to perform the drum packing process in unsafe working posture. In the workstation, he has to bend downwards his body to reach the wooden planks in the right side. Due to improper workstation design, the operators exposed to various ergonomics risk factors (ERFs). In the drum packing workstation, there are two ergonomics risk factors involved which are awkward working posture and repetitive movement. Those ERFs may contribute to low back pain and muscle fatigue as well as psychological fatigue to the workers. Previous studies have shown when the workers exposed to awkward working posture, they may have occupational injuries associated with low back pain (Darren, M. R. et al., 2010). Based on above mentioned situation, the existing workstation exposes the operators to several difficulties such as poor occupational health, low motivation, reduce productivity and increase of cost for medical treatment.

For the occupational health, since the operator have daily exposed to the ergonomics risk factor stated above, this will effect the operators health such as muscle fatigue and low back pain. The workers motivation will be affected since they suffered from the pain. Due to the operators are not in a good health, the productivity also could be affected. Each of company has production schedule to plan the manufacturing of product. If the operator did not proceed the task given as planned, this will make delay in production. The condition becomes more severe if the operators have to refer to medical treatments. This will also effect to the company schedule, because some of the company only have trained operators to proceed the specific job, if the operators idle or get medical leaves from the doctor, this will lead to machine halt until the operators are fully recovered.

1.3 Objectives of Study

To solve the above mentioned problems, this study is conducted to achieve the following objectives:

- 1) To assess psychophysical experience and working posture of operators while performing the drum packing process.
 - The data will be collected through questionnaire survey among the operators at the drum packing workstation.

- 2) To redesign the drum packing workstation by considering information from the operators and their section leaders.
 - The existing workstation will be redesigned by improving posture of the operators.

- 3) To simulate the working posture of operators while performing drum packing process at redesigned workstation.
 - This study performs a comparison of working postures between performing drum packing process at the existing workstation and the redesigned workstation.

1.4 Scope and Limitation of Study

The scope of this study is focusing on the drum packing workstation in the medium-scaled electrical cable manufacturer. The subjects of the study are two male operators at the drum packing workstation. The working posture and movements of the operators will be analysed during the 8 hours of working period. Indeed, the limitation of the study is only redesign the workstation to simulate the existing workstation and the redesigned workstation.

1.5 Significant of Study

This study may offer several potential benefits to the following parties such as:

- 1) Industry
 - With the improvement at the workstation, it can reduce the musculoskeletal disorders (MSDs) among the workers. The findings of this study can also be used by the Safety and Health committee of the related company to promote safe working practices in the workplaces.

2) University

- This study can be a future references to the student if they also involved in this field of study to accomplish their final year project.

3) Authorisation Institution

- The National Occupational Safety and Health (NIOSH) of Malaysia can refer this study to improve existing guideline on the safe drum packing process.

1.6 Outline of the Study

In chapter one, it provides background of the study, the problem statements of the study, objectives, scope and limitation of the study, significant of study and also the outline of the study. The main objectives of the project are to assess Psychophysical Experience and operators' posture of workers while performing the drum packing process, to redesign the drum packing workstation by considering information from the operators and their section leaders and to simulate the working posture of operators while performing drum packing process at redesigned workstation. The scope and limitations of the project is focusing on the drum packing workstation in the medium-scaled electrical cable manufacturer and redesign the workstation to simulate the existing workstation and the redesigned workstation. In chapter two, the literature review is provided in order to support the discussion and the methodology of study. The literature review was performed by online search by journals and other reliable resources. Chapter three discusses the method applied to redesign the drum packing workstation. Chapter four presents the data and results obtained through the questionnaire survey. Last but not least, chapter five concludes the findings of study and it provides recommendations for future improvement.

CHAPTER 2

LITERATURE REVIEW

This chapter provides literature review on psychophysical experience and working posture for workers in manufacturing industry. Additionally, review on workstation design applied in the manufacturing industry is presented. Finally literature survey on simulation of working posture is explained. This chapter begins with review on psychophysical experience and working posture.

2.1 Determination of Psychophysical Experience and Working Posture

2.1.1 Psychophysical Experience

Fatigue and recovery are periodic processes in every living organism. In the study of Rohmert (1973), it is stated fatigue can be described as a state which is characterized by a feeling of tiredness combined with a reduction or undesired variation in the performance of the activity. Moreover, Gescheider(1997) describes the psychophysics as the scientific study of the relation between stimulus and sensation. The relationship between biomechanical loads on several body joints and subjective rating of joints load are related to the ergonomic risk factor. Ramazzini (1770) states that a variety of common workers' diseases appeared to be caused by prolonged irregular motions and postures. Ergonomics is the laws of work that define the limits

to the human capability. There are 7 types of ergonomics risk factors which are repetition, awkward posture, excessive force/ forceful exertion, vibration, static postures, contact stress and extreme temperature. According to Joseph (1994), the goal of ergonomics is to improve the safety, comfort, and efficiency of the workplace. The advantages of ergonomics are it can reduce the ergonomics risk factors, lower employee turnover, reduced rework and improved employee comfort.

2.1.2 Working Posture

In industrial workstations, the workers may expose to various ergonomics risk factors such as awkward working posture. To ensure the workers practice safe working posture, the workstations and tasks should be designed ergonomically to avoid strain and damaged to any part of the body such as tendons, muscles, ligament and especially the back (Dahalan J., 2005). Normally, the employees tend to accept the working condition without considering their occupational health such as body strain, until they feel the pain without knowing the root cause of the problem. If the task and equipment do not consider ergonomics principles in their design, workers may expose to excessive physical stress, strain, and overexertion, including vibration, awkward posture, forceful exertion, repetitive motion and heavy lifting. These stressors can lead to various occupational injuries such as musculoskeletal disorders, cumulative trauma disorders (CTD) and nervous systems disorder. (Amstrong et al., 1982).

2.1.3 Ergonomic Assessment Tools

There are several methods to assess the psychophysical experience and working posture. The methods can be classified as subjective method, direct technical measurement method and semi-qualitative method.

2.1.3.1 Subjective Method

Through the subjective method, questionnaire and Visual Analogue Scale (VAS) are commonly used. The purposes of having questionnaire for survey are to obtain accurate and relevant information that will be used in designing a product based on the customer's requirements. Basically, a questionnaire consists of personal background and work activities, psychophysical experience, history and treatment, and the requirement for improvement regarding hazards at workstation. According to Wai, C.L, (2001), in designing a proper questionnaire, the questions that will be asked need to be phrased based on certain rules, which are by using short and simple sentences in order to avoid any confusing and the sentences itself needs to be in one clause instead of two or more clauses in one sentences. Meanwhile, a VAS is a measurement instrument that tries to measure a characteristic or attitude that is believed to range across a scale of values that a patient feels ranges across a scale from none to and extreme amount of pain. From the patient perspective this spectrum appears continuous and their pain does not take discrete jumps, as a categorization of none, mild, moderate and severe would suggest. Operationally, a VAS is usually a horizontal line, 100 mm in length, anchored by word descriptors at each end as illustrated in Figure 2.1. The patient marks on the line that they feel represents their perception of their current state. The VAS score is determined by measuring in millimetres from the left hand end of line to the point that the patient marks. (D. Gould et al. 2001)

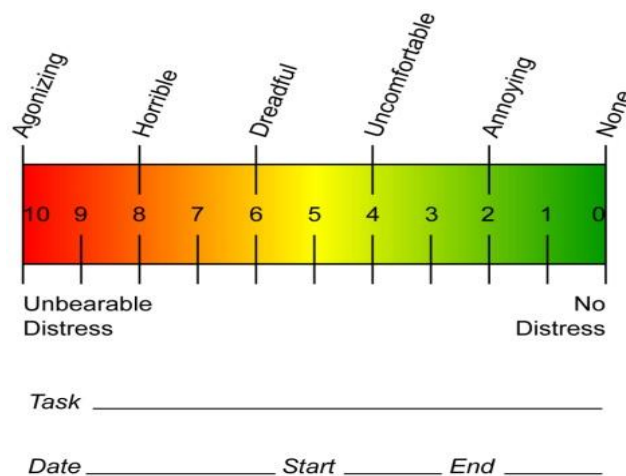


Figure 2.1 Example of Visual Analogue Scale

(Source: <http://ergonomics.about.com/od/ergonomicbasics/ss/painscale.htm>)