

THE EFFECT OF WORK-REST SCHEDULE AND TYPE OF COGNITIVE  
WORKLOAD ON MENTAL FATIGUE

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THE EFFECT OF WORK REST SCHEDULES AND TYPE OF COGNITIVE  
WORKLOAD ON MENTAL FATIGUE

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## **ABSTRACT**

The purpose of this research is to study the impact of workload and work-rest on the mental fatigue since the cognitive work such as inspection, welding and many more where it required very attention visual and induced the mental fatigue. This research was conducted through the design of experiment with the two levels and two factors and 7 workers in welding activity were involved in this experiment. Time reaction has being used as response variable in the experiment and the data were analyzed with Two-way ANOVA to identify the significant impact of the factors on the mental fatigue as well as the significant interaction from that both factors. The best setting for positive impact on mental fatigue was developed through the interaction plot. Paired T-test and regression test also has been used in this experiment for verification and validation. Two-way ANOVA test has been showed that both factor workload and work-rest gave significant impact to the mental fatigue and this both factor also have a strong relationship and interaction that can influencing the level of mental fatigue. The interaction plot also showed that the best setting to reduce the level of mental fatigue is with the run order from light workload versus short and frequent work-rest. The result from the verification and validation proved that this experiment was valid and can be used for future research.

## ABSTRAK

Tujuan utama penyelidikan ini adalah untuk mengkaji kesan bebanan kerja dan waktu rehat terhadap keletihan mental semenjak permintaan kerja-kerja kognitif didalam dunia industry. seperti pemeriksaan bahan kecil, kimpalan dan banyak lagi dimana kerja-kerja ini memerlukan tumpuan yang tinggi dan boleh menyebabkan keletihan mental. Kajian ini menggunakan pendekatan eksperimen "Design Of Experiment (DOE) dengan dua level dan dua faktor. Seramai 7 orang pekerja kimpalan terlibat didalam eksperimen ini. Masa tindak balas telah digunakan sebagai pemboleh ubah yang bergerak balas. dan data yang telah diperolehi di analisa menggunakan "Two-way ANOVA" untuk mengenal pasti jenis faktor yang ketara dan juga hubungkait yang ketara dalam memberikan impak kepada terhasilnya keletihan minda manakal "regression" dan "paired T-test" digunakan untuk pengesahan eksperimen "Two-way ANOVA telah menunjukkan bahawa kedua-dua faktor adalah faktor yang ketara dalam penghasilan keletihan minda dan begitu juga dengan hubungkait yang juga memberikan impak ketara. Melalui enteraksi plot, eksperimen ini memperolehi tetapan yang terbaik untuk mengurangkan keletihan minda iaitu melalui tetapan kerja berat dengan rehat sekejap dan berkala. Selepas itu, melalui "regression" dan "paired T-test" eksperimen ini didapati betul dan tepat. Ini membolehkan pengkaji yang lain menggunakan tetapan eksperimen ini untuk kajian masa hadapan.

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## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Introduction**

Chapter one will consist of general background of this study which is problem statement, objective as a research's goal, research scope and some limitation during the research. Basically, this chapter consist of several sections which are introduction, background of study, problem statement, objective, scope, and significant of study that will assist this research to achieve goal.

#### **1.2 Background of Problem**

Ergonomic is one of the approaches where the safety can be improved properly and successfully. Basically, ergonomic is the design of workplace where it designed to fit the human body through engineering control and administrative control. Both engineering and administrative control are very important to make sure that the ergonomic approach will give the significant to the employee and organization. Sometimes, simple improvement by ergonomic approach will give big impact on the safety and quality in the organization but not all the employer willing to invest their money for ergonomic and poor ergonomic will lead to fatigue to employee thus can impairs their performance hence at the end the company will produce a very bad quality of product and worker.

In this new era of industrial globalization, manufacturing industry entire world greatly shows the growth of product demanding make the manufacturer pushed their production to produce mass of product in order to achieve the demand. This scenario indirectly helps people to have the opportunities of employment and the development of jobs and careers. Despite, this growth of manufacturing industry will give the big chance of poor ergonomic problem at workplace that lead to accident and death thus can reduce the quality level of product and employee performance.

Poor ergonomic management also makes the employee will experience fatigue and stress and coupled with given task or work load beyond their capability and capacity thus lead to the poor of performance and produced the poor quality of product and this situation can make the organization experience in the stress condition and make their business become worth. Workers who are working on a demanding task for a prolonged period of time will often experience in fatigue on both mental and physical. Fatigue is an unpleasant condition where the worker will lead to injury and death. According to Chompu-Inwai (2010) who studied the impact of work-rest period on mental fatigue in inspection task with microscope, fatigue can be classified into two categories, physical and mental. Physical fatigue causes painful stiffness on abdominal muscles and mental fatigue causes dimness, tiredness and laziness.

Many companies in industry try to reduce and eliminate the accident by promoting the zero accident and loss time injury but their approach toward the safety improvement seem too slow and no improvement. They just encourage the employee to being safety but no safety actions have been taken by employer. In order to overcome this problem, the organization needs to improve their working place and system hence can reduce the worker stress and fatigue. There are many approaches that can be implemented to reduce fatigue and stress and one of them is through ergonomic improvement approach. Successfully ergonomic improvement implementation will ensure that all the fatigue problem through physical and mental can be reduce and it make the employee work in conducive and comfortable condition. It is because the ergonomic approach paid all the aspect regarding to the

demand of human body through the engineering and administrative control. Lee (2005) stated that ergonomics is about promoting compatibility between humans and systems and Fernandez (1995) found that ergonomics is the design of workplace, equipment, machine, tools, product, environment and system, taking into consideration the human's physical, physiological, biomechanical, and psychological capabilities and optimizing the effectiveness and productivity of work systems while assuring the safety, health and wellbeing of the workers. In general, the aim in ergonomics is to fit the task to the individual, not individual to task.

Employer need to realise how important the ergonomic improvement for their organization in order to sustain their business and improve the productivity so can meet the customer demand without give any harmful to their employee that cause from fatigue. Imagine that the employer can achieve their target based on quantity but not consider about ergonomic issues, their achievement may be able to stand only for a short period of time and for the long time period they will face with many problems related to their worker's fatigue that will affect the health of the worker thus can impairs quality products of company. Fatigue can makes worker stress, feel uncomfortable, slow reaction time and sleepiness and this effect will impairs their performance According to Gutnick (2007), a study by The National Safety Council established that on an average workday, one million employees will be absent from work due to job stress. Working environment is very important in order to reduce worker's fatigue that will improve their performance Taiwo (2009) stressed that about 86% of productivity problems reside in the work environment of organization and previous studies also found that an employee's workplace environment is a key determinant of their level of performance. Kingsley (2012) claims that poor workplace environment influences employees health and safety, error rate, level of innovation, collaboration with other employee, absenteeism, and ultimately how long they stay in the job.

Actually, good working environment is not only focus on providing clean workplace, natural light and colour, good communication, reward culture and etc. Provide an adequate rest for the worker also is a one of good environment in the workplace that can reduce fatigue. Konz (1998) found that, one of the main reasons

that people become fatigued is insufficient rest. Proctor *et al.* (1996) conducted a study on automotive workers and found evidence to support a link between the number of consecutive days worked and the number of overtime hours worked and increased feelings of depression, fatigue and confusion. B. Johanna and W. Joanne (2003) in their research suggested that there is an association between working long hours and fatigue. Working long hour mean that there are inadequate rest in their work, thus it is very important for employer to provide a very adequate work rest.

### 1.3 Problem Statement

Manufacturing industry has generated a large amount of production in order to cope with the high global demand and competition. This situation make the employer tend to push their employee to work harder than usual without consider their working system and environment that will effects their employee's fatigue thus impact the safety and health. However, many of researchers just study on physical fatigue and not on mental fatigue that also can affect the employee's health and safety.

Welding activity for example is one of the jobs that require attention in every steps and very cognitively demanding tasks thus it is very need a study about mental fatigue. Linden *et al.* (2003) stated that when people are working on a cognitively demanding task for a prolonged period of time, they will often experience mental or cognitive fatigue, reflected in deteriorated task performance and reduce motivation to continue to work on the task at hand. While Lorist *et al.* (2012) claimed that fatigue from prolonged mental work has been found to impair performance in a variety of cognitive tasks.

Marcora *et al.* (2008) found that mental fatigue impaired physical performance in humans. Baker *et al.* (1994) stated that in industry, many incidents and accident have been related to mental fatigue as the result of sustained performance, So that to prevent any incident and accident cause from mental fatigue,

there are need to study about the best work-rest schedule in order to avoid the prolonged period of time in cognitive task.

There is not much study on the impact of work rest schedule on mental fatigue by previous researcher especially in Malaysia. There are only one paper that has been study this issue; there are Inwai (2010). They have been studied about impact of work-rest period on mental fatigue in inspection task with microscope, the case study of hard disk drive component manufacturing company but they do not concern on the level of workload. However, there are a lot of researcher was studied on the impact of work-rest schedule on VTD user such as Asfour (1987) that suggested a 30-minute break after 3 ½ hours of VDT work, Floruet *al.* (1985) who have found that 40-minute work followed by a 5-minute break will eliminate the performance decrements. Boucsein and Thum (1995) recommended that users should take a 7.5-minute rest break after 50 minutes of VDT work until noon and a 15-minute break after 100 minutes of work in the afternoon, Kopardekar and Mital (1994) propose of 60-minutes work period followed by a 10-minute break schedule. There are so many studies about the work rest in generally but the impact of work-rest schedule on mental fatigue remains largely unknown.

Manufacturing industry in Malaysia have been growths rapidly as global demand in this industry are getting higher every day, so there a lot of products have been produced and required welding activity especially on the metal product makes the workers having a high workload every day and this give the chance for them experienced in mental fatigue that impairs the employee's performance and eventually produce a bad quality of product. Until this day, there are no studies on mental fatigue in cognitive activity especially for welding activity and how to encounter this issue. Hence, the aim of this research is to provide a best work-rest schedule for welding activity in order to reduce mental fatigue.

#### **1.4 Research Objective**

The objective will simplify the researcher to achieve the project's goal and as project guidance whether it specify, measurable, attainable, reliable and tangible or not. The objectives of this research were:

- 1) To identify the impact of work-rest schedule and cognitive work load of welding activity on mental fatigue.
- 2) To develop the relationship between type of workload and work-rest.
- 3) To validate the experiment.

#### **1.5 Research Scope**

The research scope in this study may be listed as below:

- 1) The research will focus on specific cognitive task only. (welding activity)
- 2) The experimental will be carried out by design of experiment of two levels at oil and Gas Company.
- 3) Psychomotor test of simple reaction time will be tested on subject in the experiment to measure the level of mental fatigue.
- 4) Focus on mental fatigue by attention.



## **1.6 Significant of The Research**

This research may be able to provide a guideline of proper type of work-rest in order to reduce mental fatigue based on type of cognitive work load for electric and electronic industry so that their employee performance can be improve thus can increase their productivity. Furthermore, this approach is very low cost because they just need to reset up their work-rest schedule in order to get the high performance of their worker.

## **1.7 Expected Outcome**

At the end of this research, the researcher expected that the short and frequent work-rest schedule may reduce the mental fatigue in whatever type of cognitive work load.

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