

DETERMINATION OF WORK-REST SCHEDULE BASED ON FATIGUE  
AMONG WELDERS AT CONSTRUCTION OF MARINE FACILITY  
PENGERANG PROJECT

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Specially dedicated,

To all beloved persons who are very important to me to build the success of my life,

To my husband and mother

**Irwan bin Ishak, Zaleha Binti Mohamed Amin**

To my sisters and brothers, lecturers, fellow friend and my colleagues for their support and encouragement.

My supervisor, **Dr Affandi bin Mohd Zainal** for all his support and guidance support given. For **HIM** who inspire and give me true strength to make this project possible and worthwhile.

May **Allah s.w.t** bless you all.

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## **ABSTRACT**

This study is keen on Determination of Work-Rest Schedule Based on Fatigue Among Welders at Construction of Marine Facility Pengerang Project that could help construction company in Malaysia to gain information and knowledge about fatigue during welding work. A welding work as common practicing method in construction industry such as welding structure, pipe, vessel and etc.. In order to achieve this study, the survey is expected to reveal the level of fatigue in the construction sector via a questionnaire. The survey had covered about 50 respondents chosen from welders in pengerang project. The survey findings were analyzed using statistical analysis package SPSS 20. This study had attempted to find out to investigate applicability of Determination of Work-Rest Schedule Based on Fatigue Among Welders at Construction of Marine Facility Pengerang Project. Finally, this project culminates with a discussion and the general conclusions from the survey findings. The result finding is expected to be adequate and useful information for forthcoming research purpose especially for fatigue among welders.

## **ABSTRAK**

Kajian ini merujuk kepada Penetapan Jadual Kerja-Kerja Berdasarkan Keletihan Antara Pengimpal di Pembinaan Projek Pengerang Kemudahan Marin yang boleh membantu pembinaan di Malaysia untuk mendapatkan maklumat dan pengetahuan tentang keletihan semasa melakukan kerja-kerja kimpalan. Kerja kimpalan sebagai kaedah amalan biasa dalam industri pembinaan seperti struktur kimpalan, paip, vesel dan lain-lain. Untuk mencapai kajian ini, dijangka menunjukkan tahap keletihan dalam sektor pembinaan melalui soal selidik. Kaji selidik tersebut telah merangkumi kira-kira 50 orang pengimpal telah dipilih daripada kalangan pengimpal yang bekerja di projek pengerang. Hasil kajian dianalisis menggunakan pakej analisis statistik SPSS 20. Kajian ini telah cuba untuk mengetahui penyesuaian penggunaan Penentuan Jadual Kerja-Kerja Berdasarkan Keletihan Antara Pengimpal di Pembinaan Projek Pengerang Kemudahan Marin. Akhirnya, projek ini berakhir dengan perbincangan dan kesimpulan umum dari hasil kajian. Penemuan hasil dijangka menjadi maklumat yang mencukupi dan bermanfaat untuk tujuan penyelidikan yang akan datang terutama untuk keletihan di kalangan pengimpal.

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## CHAPTER 1

### INTRODUCTION

#### 1.1 Introduction

This chapter provides a detail analysis on the overview of study, background of the problem, problem statement, project objective and scope and limitation of the project.

#### 1.2 Overview of Research

Ergonomic can be defined as reducing fatigue by designing tasks within people's work capacities. It also can define as the practice of designing products, systems or processes to take proper account of the interaction between them and the people that use them. It is a multidisciplinary field incorporating contributions from psychology, engineering, biomechanics, industrial design, physiology and anthropometry. In essence it is the study of designing equipment and devices that fit the human body and its cognitive abilities according (Frederic Bartlett et al., 1949). The two terms " ergonomics " and " human factors " are essentially synonymous. The International Ergonomics Association defines ergonomics or human factors as follows: Ergonomics is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance.(Website—International Ergonomics Association)

When workers work under circumstances which require a high concentration of physical, mental and visual energy, fatigue can develop easily and take its toll on productivity and quality. In addition, poor working environment that poses a lot of ergonomic stressors can also contribute to workers fatigue. Meanwhile ergonomic interventions such as redesigning of tools, methods, workstation and layout can minimize factors that can cause fatigue. Effective work-rest schedule can be economical and easy to implement to facilitate fatigue recovery.

Although fatigue has been recognised as a potential factor which may contribute to accidents at sea (Couper1996; McCallum et al., 1996; Osler 1997), little is known about the extent and aetiology of fatigue in sea activity. Evidence from Australian and other seaman groups suggests that the work and sleep conditions experienced at work area contribute to stress (Parker et al., 1997) and fatigue (Sanquist et al., 1996, 1997). To explore the potential relationship between work, sleep, stress and fatigue in sea activities, evidence from the literature, which for the most part was not collected from studies of marine facility, has been examined.

Although fatigue is a concept that has been widely examined in the literature, there has been no clear definition of it. This is due largely to the complex nature of fatigue and the fact that it involves a number of psychosocial and behavioural processes (Shen, Barbera & Shapiro, 2006). As a consequence, there are numerous definitions available that vary depending on the origin of the investigation. Shen et al. (2006) suggest that fatigue is “an overwhelming sense of tiredness, lack of energy and a feeling of exhaustion, associated with impaired physical and/or cognitive functioning”. This definition was adopted for the purposes of examining fatigue in construction workers.

While numerous studies have examined fatigue in one form or another, limited research has been conducted with construction worker samples (Lingard & Francis, 2004). Studies conducted with broader occupational groups show that fatigue is predictive of injuries and near-miss accidents at work (Gold, Rogacz, Bock, Tosteson, Baum et al., 1992); turnover intentions (De Croon, Sluiter, Blonk,

Broersen, & Frings-Dresen, 2004); as well as sickness and absenteeism (Dembe, Erickson, Delbos, & Banks, 2005).

Australian studies of construction industry workers has shown that fatigue is a significant contributor towards poor work-life balance (Lingard & Francis, 2004; Townsend, Brown, Bradley, Lingard, & Bailey, 2007). Lingard and Francis also found significant differences in fatigue levels between on site and off site workers, attributed to the longer hour's site workers undertook. Studies of broader occupational groups also have shown that the risk of injury or near-misses increases with longer working hours due to the associated fatigue, with the highest risk associated with shifts of 12 hours or longer (Dembe et al., 2005; Folkhard & Lombardi, 2006).

Another study conducted with construction workers found that fatigue had an impact on physical health and symptoms (Chang, Sun, Chuan, & Hsu, 2009). When comparing different worker groups, it was found that scaffolders in particular had the highest physical fatigue levels and reported shorter sleeping hours than the other groups examined (steel fixers, formworkers, electrician/plumbers, and concrete workers). The study also examined smoking and alcohol consumption and found that both smoking and alcohol consumption was quite high among construction workers and may be a contributing factor to poor health outcomes. Both smoking and alcohol consumption was highest among scaffolders, indicating that smoking and consuming alcohol may present a method of relaxation or relieving fatigue.

While many models of fatigue in employees have been developed, perhaps the most relevant to construction workers is the broad occupational model developed by Dembe and colleagues (2004). These researchers found that long work hours and overtime schedules significantly increased the risk for occupational injuries and illnesses through a causal process induced by fatigue or stress. Furthermore, the proposed model hypothesises that long work hours, commuting time and sleep behaviours has an impact on a range of (physical and psychological) health outcomes, near miss accidents at work, and job satisfaction.

### **1.3 Background of Problem**

Construction in marine environment has many ergonomic factors that can lead to fatigue. These factors can be the nature of the works, the works surrounding (air quality, hot environment, weather etc.), work-rest schedule, social environment, demographics characteristics (age, gender, height, and weight), personal habits and medical history.(J.S. Boschman, 2013).

Some tasks such as welding activity require high mental and visual concentration. High demands for mental and visual alertness, together with the surrounding stressors can lead to fatigue. Researches done in simulated environment have shown that the effective work rest schedule can reduce fatigue and heat stress when working at industries manufacture.

Accordance to Ebben (2003), rest breaks, if correctly administered, can allow an employee to recover from fatigue. Many studies have been done in real industrial setting where an effective work-rest was shown to reduce fatigue and to prevent heat stress from happening. So that from this study, accident can be prevented and no LTI (lost time injuries) occurs at this construction area.

### **1.4 Problem Statement**

Many marine construction companies use a uniform work-rest schedule that is applicable to all workers throughout the construction site, regardless of nature of their respective work or work area for each task activities. A uniform set of work-rest schedule may not be appropriate for all workers. Welders for example may require a different work-rest schedule that is more suitable for fatigue or heat stress recovery. However, no study has been done on the impact of different work-rest schedules on fatigue recovery among workers based on their scope of work or task in marine construction site.

## 1.5 Purpose of the Study

The purpose of this quantitative, exploratory, cross-sectional study was to examine the impact of fatigue on work attitudes of welders at Construction of Marine Facility Pengerang Project. Fatigue in this study was described as the psychological condition of unresponsiveness and observable or indirect indifference towards the suffering of others, and the progressive disinclination in the ability to show responsiveness to others due to excessive exposure to stressful situations (Collins & Long, 2003; Lynch & Lobo, 2012; Musa & Hamid, 2008; Newell & MacNeil, 2010).

By examining how fatigue might affect work attitudes of welders, use passive voice extent to which participants' experiences of fatigue could predict their work attitudes in the work setting can be determined. The results could be used to make empirical inferences and explanations regarding the phenomenon and the units of analysis (Creswell, 2013; Lutz & Hill, 2009). The study also controlled for the effects of work satisfaction, which is the positive aspect of trauma-related work, to provide a better understanding of the true effect of the independent variable (fatigue) on the dependent variable (work attitudes) (Lutz & Hill, 2009). By using a cross-sectional survey design, the study variables in the absence of a behaviour variable can be determined, in the bid to determine if there were significant connections between variables that were tested in the hypotheses associated with the research questions (Lutz & Hill, 2009; Yoshikawa, Weisner, Kalil, & Way, 2013).

In this study, fatigue was investigated as the independent variable, and work attitude was tested as the dependent variable. The relationships between the independent variable and the dependent variable were tested. The main focus of the study was to determine if the independent variable was a statistically significant predictor of the dependent variable. Work satisfaction was entered in the regression analysis as a moderator variable to determine the true effect of the predictor variable on the outcome variable.

The scope of this study is on work-rest schedules among welders in marine facilities construction site. The project involves the following scope:

1. Location of research at Marine facility project at Pengerang Johor. That project owner by Dialog E & C Sdn Bhd. This project involve in construction jetty including pipeline for LNG & Crude Oil.
2. To carry out experimental works in welding setting by using different work-rest schedules
3. The research focusing on 50 no's of qualified welders in range age of 21 years old to 50 years old.

## **1.6 Research Questions and hypothesis**

Question 1: How well does the level of fatigue in welders predict their work attitudes in the welding work setting?

Hypothesis 1A:  $\mu_1 = \mu_2$  The level of fatigue in welders, as measured by the Checklist individual strength (CIS) scale, is not a statistically significant predictor of their work attitudes as measured by the Job Involvement Questionnaire (JIQ), in the welding work setting.

Hypothesis 1B:  $\mu_1 \neq \mu_2$  The level of fatigue in welders, as measured by the Checklist Individual Strength (CIS) scale, is not a statistically significant predictor of their work attitudes as measured by the Job Involvement Questionnaire (JIQ), in the welding work setting.

Question 2: What is the predictive relationship between welders fatigue and their work attitudes, while controlling for work satisfaction?

Hypothesis 2A:  $\mu_1 = \mu_2$  There will be no statistically significant relationship between welders fatigue as measured by the Checklist Individual Strength (CIS)



scale and their work attitudes as measured by the Job Involvement Questionnaire (JIQ), while controlling for work satisfaction.

Hypothesis 2B:  $\mu_1 \neq \mu_2$  There will be no statistically significant relationship between welders fatigue as measured by the Checklist Individual Strength (CIS) scale and their work attitudes as measured by the Job Involvement Questionnaire (JIQ), while controlling for work satisfaction.

## **1.7 Nature of the Study**

A quantitative, cross-sectional survey design was used to examine the predicative relationships between the independent and dependent variables. Data were collected at one point in time and the results were used to form an empirical explanation of the phenomenon under study. Information was from the participants through a survey methodology, and the data was transformed to numbers to enable quantitative interpretation in the data analysis. A single group of participants was examined to understand the phenomenon of interest, a cross-sectional survey design was appropriate for this study. Both simple and multiple linear regression analyses were used to draw statistical inferences regarding how the independent variable affected the dependent variable, and the effect of the control variable on the dependent variable was examined.

The independent variable in this study was fatigue, and the dependent variable was the work attitudes of participants. Work satisfaction was used as a control variable to check the true impact that the independent variable had on the outcome variable. The survey also included a short section that gathered basic demographic information to describe the main characteristics of the participants. The data collection instruments consisted of Checklist Individual Strength (CIS), for measuring fatigue in helping professionals, and Kanungo's Job Involvement Questionnaire (JIQ) for measuring practitioners' work attitudes regarding their jobs (Kanungo, 1982). Both instruments have good validity and reliability scores, and

detailed explanations and justifications for my decision to use these tools are provided in Chapter 3.

### **1.8 Expectation contribution of this study**

Outcomes from this study can be used by the marine facility construction company management in their decision making in construction activity. The outcome also can be used for further research on work-rest schedule. It is expected that short and frequent work-rest schedule will have better impacts on welders in term of fatigue recovery and productivity of the weldment for each welders.

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