Analysis of the Effect of Work Shifts on the Fatigue Level of Operators of Balikpapan City Drinking Water Area Companies

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ABSTRACT

This study aims to investigate the effect of work shifts on the level of fatigue experienced by the operators of the production department of the Balikpapan City Regional Drinking Water Company (PDAM). This research is a type of quantitative research using a *cross-sectional* approach. The number of samples of this study was 60 operators of the balikpapan city PDAM production department spread across 6 working areas of Balikpapan City. data collection techniques by means of observation, interviews and dissemination of questionnaires. While data processing and analysis using simple linear regression analysis with the help of SPSS softwere version 22. The results showed that there was a positive and significant effect of work shifts on fatigue experienced by the operators of the production department of the Balikpapan City Regional Drinking Water Company (PDAM). The contribution of the effect of work shifts on operator work fatigue was 24.6%.

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INTRODUCTION

Optimization of the company's system performance is very dependent on the constituent elements of the system that interact with each other and are able to be in good performance. The company's work system is very dependent on human involvement in it. Without human involvement, the company's work system cannot operate properly, because humans are the determining factor that controls and runs the system [1], [2]. One of the most commonly encountered models of work systems in industry is the division of labor time or referred to as work shifts. [3] mentioned that the work shifts applied are closely related to the increase in negative impacts on human health and performance. To meet the company's production and efficiency targets, sometimes operators have to complete their work outside of work shifts. With this kind of working model, it is likely that the operator will experience fatigue in work. In the end, it greatly affects productivity and high work accident rates [4].

Various research results show that the work system with the shift model is closely related to an increased risk of various health problems, including, heart disease [5], gastrointestinal disorders [6], cancer [7], and depression [8]. Moreover, operators who work outside the work shift are particularly susceptible to work-related fatigue and/or drowsiness, which occurs as a result of circadian rhythm disturbances and lack of sleep [9]. And it was also reported that operators experienced a very significant level of fatigue at the end of the work shift compared to the beginning during the work shift period [10].

Based on a report from an international hunting organization in 2013 that every 15 years one worker dies and 160 workers develop occupational diseases. While the previous year, as many as 4 million cases each year the death rate was due to accidents and occupational diseases [11]. Then. Workers with night shifts have a 28% higher risk of accidents. The main factors are sleep disturbances, stress and fatigue. Fatigue contributes as much as 50% to work accidents. Shift work is considered a demand that puts pressure on individuals to work more optimally. If the management is poor, it will negatively affect the worker. This disruption is certainly not expected by workers and companies because it can reduce productivity and quality of performance.

By definition, fatigue is defined as an unstable physical, cognitive, and emotional symptom that is then described as a form of excessive reduction of energy (Mota and Pimenta, 2006). The prevalence of work-related fatigue has been reported to be less than 10% to more than 40% [12]. Work-related fatigue is an important issue because it can affect the performance, safety, and health of workers [13]. Therefore, the assessment of work shifts against the degree of fatigue is indispensable.

The Regional Drinking Water Company or abbreviated as PDAM Balikpapan City is a type of regionally owned business engaged in distributing clean water to the people of Balikpapan City. In order to meet the clean water needs of the community, PDAM must operate for 24 hours every day. PDAM implements three work shifts, namely the morning shift (07.00-15.00), the day shift (15.00-23.00) and the night shift (23.00-07.00) [14]. Initial survey of 10 workers on morning, day and night shifts showed that the conditions that workers often experience are frequent headaches, shortness of breath and fatigue or weakness [15]. About 10 workers complained of frequent headaches, 5 workers experienced shortness of breath and 8 workers often felt .

exhausted or weak during work. Based on the initial problems obtained, this study aims to investigate the effect of the division of work time or work shifts on the level of fatigue experienced by the production operator of PDAM Balikpapan City. From the results of this study, it is hoped that they will get recommendations for workers and company management in determining work shifts, so as to minimize the negative impact of work accidents and decreased productivity.

RESEARCH METHODS

Object and Subject of Study

This research is a type of quantitative research using a *cross-sectional* approach, where this research provides a clear picture of the situation without any intervention on the object under study. The object of this study is the effect of work shifts on the level of fatigue experienced by the operator of the Balikpapan City Regional Drinking Water Company (PDAM). Meanwhile, the subject of the study was the operator or worker of the Balikpapan City PDAM.

Population and Sample

This research was carried out at the Regional Drinking Water Company (PDAM) of Balikpapan City. The population of this study was all workers in the production section of PDAM Balikpapan City which amounted to 60 people with 3 work shifts, namely, morning shift (07.00-15.00), day shift (15.00-23.00) and night shift (23.00-07.00). The operator of the production section of PDAM Balikpapan City includes the operator of the reservoir section of the Manggar Km. 12 area, the operator of the installation area km. 8 of Balikpapan City, the installation operator of the Kampung Damai area, the installation operator of the Prapatan area, installation Gunung Sari area, barnacles area installation operator, Gunung Tembak installation operator and ZAMP area installation operator. To obtain optimal research results , the research sample used all operators of the production section totaling 60 people.

Data Types and Sources

The data used for this study consisted of secondary and primary data. Secondary data is sourced from literature reviews such as publications of scientific papers, national and international journals, reports and final projects as well as company archives related to research topics. Meanwhile, the primary data of this study were sourced from the results of field observations, interviews and the distribution of questionnaires. The questionnaires used were sourced from the results of literature reviews, and interviews with the research subjects.

Data Collection Methods

The data collection method of this study is divided into 2 parts, namely primary and tests , regression simple linear, t test and coefficient of determination test. The data processing of this study used the help of SPSS softwere version 22.

secondary data. Secondary data collection is carried out through literature reviews such as publication of scientific papers, national and international journals, reports and final projects as well as company archives related to topics research. Secondary data are used to strengthen research reasons, find research approaches, emphasize research positions with previous research and as constituent materials for research questionnaires. Meanwhile, primary data collection follows the following stages: (1) observation or field review. In this stage, the researcher conducts a direct review to get a clear picture through the process of identifying the subject and object of the study as well as matters related to the research. This includesasking for the operator's willingness to participate in this study. (2) interviews. This stage is important in the process of preparing the grains of the kuesoner. In addition to the literature review, the results of the interview were used as preparation of questionnaire instruments; (3) Preparation and dissemination of questionnaires. After passing the literature review and interview, the next stage is the preparation of a questionnaire. The questionnaire contains the characteristics of the respondents, the aitem-aitem of the statement and the assessment scale of the answers given. The grading scale uses a likert scale consisting of values 1 to 4 with the meaning of the value 1 = never, 2 = sometimes, 3 = often, and 4 = very often.

Data Processing and Analysis Methods

To achieve the research objectives, namely knowing the effect of work shifts on the operator's work fatigue level, several tests were carried out, including: data validity and reliabiliy

RESULTS AND DISCUSSION
Characteristics of Respondents

This section outlines the characteristics of the respondents involved in this study. The characteristics of respondents aim to provide a general picture of the respondents involved in the study through filling out questionnaires consisting of gender, age, level of education and the length of service, including the operator's work shift as shown in tables 1 and 2 as follows.

Table 1. Characteristics of Respondents

Variable	*n*	Percentage
Gender		
Man	60	100%
Woman	0	0%
Total	60	100%
Age		
21-30 years	17	28%
31-40 years	8	13%
41-55 years	35	59%
Total	60	100%
Education Level		
High School / Vocational School	57	95%
D1 – S1	3	5%
Total	60	100%
Service Life		
5-10 years	20	33%
10-20 years	30	50%
20-35 years	10	17%
>35 years	0	0
Total	60	100%

Table 2. Shift Frequency Distribution of Work Of Production Part Operators

No.	Working Area	Production Unit Work Section	Work Shifts		
			Morning	Noon	Night
1	Manggar Reservoir km. 12	Processing Operator	4 people	3 people	3 people
		Operator *Pump House*	4 people	3 people	3 people
2	Km. 8 Balikpapan	Processing Operator	4 people	3 people	3 people
		Operator *Pump House*	4 people	3 people	3 people
3	Peace Village	Processing Operator	4 people	3 people	3 people
		Operator *Pump House*	4 people	3 people	3 people
4	Prapatan Balikpapan	Processing Operator	4 people	3 people	3 people
		Operator *Pump House*	4 people	3 people	3 people
5	Mount Sari	Processing Operator	4 people	3 people	3 people
		Operator *Pump House*	4 people	3 people	3 people
6	Barnacles	Processing Operator	4 people	3 people	3 people
		Operator *Pump House*	4 people	3 people	3 people
7	Shooting Mountain	Processing Operator	4 people	3 people	3 people
		Operator *Pump House*	4 people	3 people	3 people
8	ZAMP Balikpapan	Processing Operator	4 people	3 people	3 people
		Operator *Pump House*	4 people	3 people	3 people

Table 1 above shows the characteristics of respondents based on gender, age, level of education and length of service. The total number of respondents involved until the data collection was completed amounted to 60 people. Based on gender, all respondents were male. Based on the age of the highest

Then based on the respondent's length of service, the respondents with the most. Service

respondents, which is between 41-55 years old, as much as 59% (35 people) while the lowest is 31-40 years, which is 13% (8 people). Based on the level of education obtained by high school or vocational school graduates at most, namely 95% (57 people), the rest are D1-S1 graduates, which are as many as 5% (3 people).

life were between 10-20 years as many as 30 people (50%). The rest is followed by a service

period of between 5-10 years as many as 20 people (33%) and 20-35 years as many as 10 people (17%). Then in table 2 displays the distribution of the frequency of shift work of operators of production parts spread across 8 working areas. Each work area consists of processing operators and *pump houses* with a division of 3 work shifts and the distribution of operators with the same number, namely work shifts morning 4 people, noon 3 people and night 3 people. If viewed based on the distribution of the number of operators based on work shifts, there are more morning work shifts than day and night work shifts. This is because the use of clean water by the community is the most and the operation and control are more intense in the morning , namely at 07.00-15.00.

Validity and Reliability

The validity and reliability test of the research data was carried out with the help of spss softwere version 22. For validity tests, the criteria or standards for assessing the validity of the data use the standard significance value with a probability of 0.05, namely if the significance value (*Sig*.) is less than 0.05 (<0.05) and *pearson correlation* is positive, then the measuring instrument is declared valid. Vice versa, if the Significance value (*Sig*.) is greater than 0.05 (>0.05) then the measuring instrument is declared invalid, and if the significance value is less than 0.05 (<0.05) but is negative, then the measuring instrument is declared invalid. The test results showed that the shift work variable with 6 measurement algorithms and the work fatigue level variable with 11 measurement algorithms were declared valid based on the significance value (*sign*.) of less than 0.05 (<0.05) and *pearson correlation* was positive.

Then, testing the reliability of the data using *the Cronbach's Alpha* value criteria. If the processed *Cronbach's Alpha* value is greater than 0.60 (>0.60) then the measuring instrument is declared reliable or consistent. The test results showed that the entire measurement instrument of the variables of work shift and work fatigue was declared relibel. This is based on the *Cronbach's Alpha* value of 0.843 for the work shift variable and 0.856 for the fatigue level variable.

Simple Linear Regression Analysis

Anali sis aims for the relationship or influence between the free variable (work shift) and the bound variable (work fatigue). The results of the linear regression test are shown in table 3 as follows.

Table 3. Simple Linear Regression Analysis Results

Model		Unstandardized Coefficients		Standardized Coefficients	t	Itself.
		B	Std. Error	Beta		
1	(*Constant*)	10.635	1.979		5.373	.000
	Shift work	.751	.192	.456	3.904	.000
a. *Dependent Variable*: Work fatigue						

coefficients[a]

Based on the results shown in table 3 above, a constant value of *unstandardized coefficients* of 10.635 was obtained, meaning that the consistent value of the fatigue level variable was 10.635 if there was no work shift variable. The value of the regression coefficient is 0.751, meaning that every 1% increase in work shifts, the variable value of the fatigue level will increase by 0.751. From these results, an equation is made, namely:

$$Y = a + b X\ldots\ldots\ldots\ldots\ldots\ldots(1)$$
$$Y = 10.635 + 0.751 X\ldots\ldots\ldots(2)$$

Based on the results of the equation above, it can be said that the work shift variable has a positive effect on the level of fatigue of the operator of the production section of the Balikpapan City Drinking Water Regional Company.

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T Test

This test was carried out to find out how the influence of free variables on bound variables in this case the effect of work shifts on the level of fatigue experienced by the operator of the production department of PDAM Balikpapan city. comparing the significance value (sig.) with the probability value of 0.05. Based on the test results , a calculated t value of 3.904 was obtained greater than the table t value of 0.254. Then based on the significance value obtained by 0.000 less than 0.05. This means that significantly the work shift affects the level of fatigue of the operator of the production section of the Regional Drinking Water Company of Balikpapan City.

Coefficient of Determination test

To measure the magnitude of the degree of influence exerted by the work shift on the level of operator fatigue, a coefficient of determination test is carried out. The result of processing *R square is* used as a reference for the value of the coefficient of determination. Based on the test results, it shows an *R square* value of 0.246. This means that the contribution of the effect of work shifts on the level of fatigue experienced by production operators is 24.6%. While the magnitude of other influences is influenced by factors that have not been studied in this study.

CONCLUSION

Based on the results and discussion above, the conclusion that can be obtained in this study is that there is a positive and significant influence on the level of fatigue that experienced by the operator of the production department of the Balikpapan City Regional Drinking Water Company (PDAM). the contribution of the effect of work shifts on the fatigue level of the operators of the production department of PDAM Balikpapan City was 24.6%. This proves that work shifts contribute to creating fatigue for the operator. In addition, the distribution of the number of operators spread across 8 work areas which is considered small results in workers having to be extra in handling work in the production section of PDAM Balikpapan City. Of course , this has an impact on increasing the level of operator fatigue. For this reason, the recommendation that can be given is that the management of PDAM Balikpapan City can improve the work system and increase the workforce in the production section. each region so that the equilibrium and equality between workload, number of workers and the division of working time can be optimized by taking into account the safety and health of labor workers.

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