International Journal of Multicultural and Multireligious Understanding

http://ijmmu.com
editor@ijmmu.com
ISSN 2364-5369
Volume 7, Issue 10
October, 2020
Pages: 70-78

An Analysis of the Impact of Workload towards the Risk of Fatigue Level on PT KCI Machinists

Handoko; Erifendi Churniawan; Aditya Wahyu Erlangga

Transportation Management Railways Polytechnic Indonesia, Indonesia

http://dx.doi.org/10.18415/ijmmu.v7i10.1997

Abstract

The operation of railway transportation especially the electric train (KRL) on PT KCI still uses GOA 0 (grade of automation). This means that this facility is manually controlled by the machinist. This kind of condition will affect the fatigue caused by the received workloads. The purpose of this study is to determine whether there is an influence of workload on the risk of fatigue and its level on PT KCI machinists, to minimize the risks from the workload by using the National Aeronautics and Space Administration Task Load Index (NASA-TLX) method to measure workload. The measurement of work fatigue uses the Subjective Self Rating Test (SSRT). Based on the 101 respondents' proceeded data, there is an influence of variable X (workload) on variable Y (work fatigue) with a value of 13.8% while the rest is influenced by other variables not under research. The value was obtained from a simple linear regression analysis process using the coefficient of determination test.

Keywords: *Grade of Automation; NASA-TLX; SSRT; Workload; Fatigue*

Introduction

According to the regulation of Indonesian Government Number 56 about Railway Administration (2009), machinist is a railroad facility crew who is in charge as the captain of train travel. In the operation of train in KRL (electric rail trains), PT KCI still using GOA 0 (grade of automation) which means that the machinist manually controls the facility. Different from MRT (mass rapid transit) which already used the GOA 2, where the machinist just in charge of opening and closing the door and the entire facility controlled by OCC (operational control center). If a disturbance occurred, then the machinist has the right to manually control the facility. This can affect the main duties and responsibilities to be more difficult in operating GOA 0 on KRL. The machinist demanded to be awake and focus while in service because the machinist is fully in charge of the control. If only one small mistake happened, the machinist is in charge of the safety of thousands of passengers. Since the implementation of GAPEKA 2019 on rail travel traffic both on train and KRL, for about 9 travel of KRL daily schedule were added from 81 loops to 90 loops. On the total number of train facilities, there are 112 train additions from 945 to 1057 trains. In 1 series of KRL with 12 train stamformation on a peak hour, the maximum capacity reached 120 passengers per train or 1440 passengers in 12 trains. With those number of passengers, the duty of the machinist will be more difficult. Moreover, when the accumulation of passengers at the station in the morning and evening peak hour. In the past 10 years, there was no KRL accident caused by the workload demands of the machinist in service. However, with the absence of machinist assistance in the cabin on the KRL travel, this research is needed to guarantee the safety and expected to minimalize risks from unwanted problems, for example, the machinist is overly exhausted that he passed out caused by workload.

The purpose of this study are to identify the effect of workloads towards the risk of Machinist fatigue level on PT KCI UPT Crew KA Depok and to investigate how big the influence of the risk level of work fatigue caused by the machinist received workload of PT KCI UPT Crew KA Depok.

Research Methods

This research was using a mixed-method or a combination of a quantitative and qualitative approach. According to Sugiyono (2011: 193-330) interviews, questionnaires, observation, documentation, and triangulation could be used in terms of data collection techniques. In this research, the data was collected via Google form. NASA TLX method was implemented as the approach on workload measurement and the Subjective Self Rating Test for the work fatigue measurement that the data processing stages were already available. SPSS (Statistical Product and Service Solution) application was used for processing the computational software program data analysis and calculator as the manual calculating tool. This computation program was used because it could analyze statistics and management system with comprehensible processed data display.

The research procedure was using a computer as the computing media, then the data were analyzed using simple linear regression analysis. The implementation of this method was to measure how big the effect of the independent variable or variable X towards dependent variable or variable Y with the provision of the independent variable (x) was one (1) and have a linear relationship between the independent variable (X) and dependent variable (Y). In the simple linear regression analysis, the data collection and process result from the workload questionnaire and the level of fatigue proceeded to the SPSS application to find the relation between variable X and Y of this research. Hypothesis testing was used to find the significance of the regression coefficient. The researcher used this hypothesis:

Ho = Workload (X) does not affect the Machinist Fatigue of UPT Crew KA Depok

Ha = Workload (X) affect the Machinist Fatigue of UPT Crew KA Depok

Results and Discussion

Respondents Characteristic

The respondents of this research were 101 machinists of PT KCI UPT Crew KA Depok. The researcher categorizes the respondent's characteristics based on the respondent’s gender, age, length of work, and last education.

Table 1. Respondent’s Age

Age			
<21 Years	21-30 Years	>30 Years	Total
0	68	33	101

From the results above, the respondent's characteristics were 101 male or 100% of the total respondents. From a total of 101 machinists, there was no respondent with age under 21 years or 0%, 68 respondents with the age of 21 -30 years or 67%, and 33 respondents with age above 30 years or 33%.

Table 2. Respondent's Last Education

Last Education					
Senior/Vocational High School	D3	S1	S2	S3	Total
93	4	4	0	0	101

Based on the characteristic above, it showed that the last education majority of the machinist respondents of UPT Crew KA Depok were Senior/Vocational High School level with 93 respondents or 92%, then at D3 level with 4 respondents or 4%, 4 machinist respondents at S1 level or 4%, and no machinist respondents at S2 and S3 level or 0%.

Table 3. Length of Work

Length of Work			
<5 Years	5-10 Years	>10 Years	Total
4	86	11	101

Based on the Length of Work table above, most of the machinist respondents of UPT Crew KA Depok with 5-10 years length of work were 86 respondents or 85%, then more than 10 years length of work with 11 respondents or 11%, and less than 5 years length of work with 4 respondents or 4%.

NASA-TLX

The measurements of the machinist's workloads were done by using the National Aeronautics and Space Administration Task Load Index method. According to Hancock & Meshkati (1988) the steps of workload measurements were as follows:

1. The explanation of mental load measurement
2. Weighting
3. Scoring / Rating
4. Measuring the product score by multiplying the rating with the weight factor on each descriptor
   Product = Rating x Weight factor (1)
5. Measuring Weighted Workload (WWL)
   $WWL = \sum product$ (2)
6. Measuring the average WWL
   $Skor = \frac{\sum(weight\ rating)}{15}$ (3)
7. Classify the workload based on the NASA-TLX score
   <50 = low
   50-80 = moderate
   >80 = high

Table 4. Workload Classification

Information	Total
Low (<50)	2
Moderate (50-80)	57
High (>80)	42

Only 2 machinists with low workload or 2%, then moderate workload with 57 machinists or 56%, and high workload with 42 machinists or 42%. From the classification above, most of the machinists in UPT Crew KA Depok received a relatively moderate workload.

Subjective Self Rating Test (SSRT)

According to the result of Subjective Self Rating Test fatigue level measurements, there were 56 machinists or 55% who experienced a low level of fatigue, then 41 machinists or 41% with a moderate level of fatigue, only 4 machinists or 4% with a high level of fatigue, and no machinists experienced a very high level of fatigue. The findings of the machinist's fatigue level classifications above were most of the machinists experienced a low level of fatigue. The risks caused by a low level of fatigue towards the KRL travel safety and machinists in services was low, while only 56 machinists experienced a moderate level of fatigue, 4 machinists experienced a high level of fatigue, and no machinist experienced a very high level of fatigue.

The respondent's data on the questionnaire were measured. The UPT Crew KA Depok machinist’s level of fatigue score level after measured with Subjective Self Rating Test were stated in the table below:

Table 5. Work Fatigue Measurements Result

Name	Total Score	Information
Nopa Ditya P	68	Moderate
M Taufik	66	Moderate
Kurnia A	62	Moderate
Mei Tri S	67	Moderate
Iwan F	52	Low

After all steps of UPT Crew KA Depok machinist’s work fatigue level measurements completed, the next step was the classification based on the total score. The detail of the Subjective Self Rating Test method work fatigue classification was stated in the table below:

Table 6. Fatigue Level Classification

Information	Total
Low (30-52)	56
Moderate (53-75)	41
High (76-98)	4
Very High (99-120)	0

Classic Assumption Test

Linearity test, normality test, and heteroscedasticity test were 3 classic assumption methods that used in this research.

1. Linearity test

   Linearity test was needed as one of the simple linear regression analysis requirements. Simple linear regression could not be done if there was no linear value between workload variable (X) and work fatigue variable (Y).

Table 7. Linearity Test Results

			Sum of Squares	df	Mean Square	F	Sig.
Work Fatigue*Workload	Between Groups	(Combined)	5.215,700	40	130.392	1,903	0,012
		Linearity	1.291,41	1	1291,411	18,851	0,000
		Deviation from Linearity	3.924,29	39	100,623	1,469	0,089
		Within Groups	4110,36	60	68,506		
		Total	9326,059	100			

From the table above, it could be seen that the significance score of Deviation from Linearity was 0.089 greater than 0.05, then there was a significant linear relationship between workload variable and work fatigue variable. A good relationship between variable X and variable Y was that there was a linear relationship.

2. Normality test

Table 8. One-Sample Kolmogorov-Smirnov Test

		Unstandardized Residual
N		101
Normal Parameters[a]	Mean	.0000000
	Std. Deviation	896.362.025
Most Extreme Differences	Absolute	.076
	Positive	.076
	Negative	-.059
Kolmogorov-Smirnov Z		.767
Asymp. Sig. (2-tailed)		.598

From the normality test above, the asymp. Sig. (2-tailed) score was 0.598 greater than 0.05. From this result, it could be concluded that the data were normally distributed. A good normality test result was when the asymp. Sig. (2-tailed) score was greater than 0.05. From the normality test result above, the normality test requirement was fulfilled.

3. Heteroscedasticity test

Heteroscedasticity test was used to find out the regression model, there was an unequal variation of the residual value on one observation to another. The heteroscedasticity test result with glejser test method by using SPSS16 showed in the table below:

Table 9. Heteroscedasticity test

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.112	3.906		1.309	.194
	Workload	.022	.050	.044	.440	.661

From the heteroscedasticity test table above, it showed that the significance value (sig.) of workload as the independent variable (X) was 0.661. The significance value was greater than 0.05 then it could be concluded that there was no heteroscedasticity.

Simple Linear Regression Analysis

Simple linear regression was the functional relationship or relationship between one independent variable and one dependent variable (Sugiyono, 2011:261). The regression coefficient value was explained in the table below:

Table 10. Simple Linear Regression Test

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	30.250	6.055		4.996	.000
	Workload	.310	.078	.372	3.989	.000

The following equation was obtained:

$Y = 30{,}250 + 0{,}310X$

The regression equation above explained as follows:

a) a = constant number of unstandardized coefficients, with a value of 30.250. This constant number indicated that there was no workload (X) then the work fatigue (Y) with a value of 30.250.

b) b = the coefficient regression value of this research was 0.310 which means that every 1% addition workload level (X) then the work fatigue (Y) will add 0.310.

Hypothesis Testing

There were 2 steps in testing the hypothesis of this research, those were the t-test and determination coefficient test (R square). This hypothesis testing was needed to find did the independent variable (X) regression coefficient significantly affects the variable dependent (Y)? The hypothesis of this research are as follows:

a. Ho = Workload (X) does not significantly affect work fatigue (Y);

b. Ha = Workload (X) significantly affect work fatigue (Y).

To determine whether the regression coefficient was significant or not between variable X and Y, Hypothesis testing by using t-test and regression coefficient was done in the table below:

1. T-test

The t-test was implemented in this research to identify how high the variable independent (X) affects the variable dependent (Y). The SPSS16 t-test results showed in the table below:

Table 11. T-test

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	30.250	6.055		4.996	.000
	Workload	.310	.078	.372	3.989	.000

From table 11 above, the t value and significance value of variable X (workload) are 3.989 and 0.000. The result of the measurements using t table formula = $\frac{0,05}{2}$, 101-1-1 = 0,025, 99. The obtained degree of freedom was 99, with an alpha value of 0.025. Therefore, the t table value was 1.984. The t value was 3.989 greater than the t table with 1984 and significance value 0.000 smaller than 0.05. From the t-test results, it could be concluded that Ho was rejected and Ha accepted. So, workload significantly affects work fatigue.

2. Coefficient of determination test (R square)

Classic assumption coefficient of determination test implemented to investigate how high the variable X affect variable Y according to the R square or stated in the table below:

Table 12. Coefficient of Determination Result

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.372[a]	.138	.130	9.009

The R square value was 0.138. Based on the measurements, the obtained Kd = 0,138 x 100% = 13,8%. It could be concluded that the UPT Crew KA Depok workload variable (X) effect on the work fatigue variable (Y) was as much as 13.8%. The other 86.2% were affected by other factors that not under research by the researcher.

Conclusions

According to the results of this research, it could be concluded that the relationship between workloads or variable X and work fatigue or variable Y was linear. It could be seen from the results of the researcher analysis based on the google form questionnaire about workloads. Most of the machinists experienced a high level of workloads with 56% and on the level of work fatigue, most of the machinists experienced a low level of fatigue with 55%. The risk of fatigue caused by the machinists' workloads was low. It could be seen from the measurement result of the Subjective Self Rating Test measurement mehod.

Another conclusion is workloads had a positive effect on UPT Crew KA Depok machinist's work fatigue. It was proven by the results of the SPSS16 software analysis of the measurement. The t value on the hypothesis testing, the obtained t-test was 3.989. That value was greater than the T table value with 1.984. From these results, the variable X significantly affect variable Y. If it was based on significant values of each variable which was 0.000, smaller than the alpha value which had been specified as 0.05. There was a significant effect between workload and work fatigue. Referring to the results of the coefficient of a determination hypothesis test (R square), the effect was with the value of 13.8%, and the rest were affected by other factors that not under research by the researcher.

References

Arasyandi, M., & Bakhtiar, A. (2016). Analisa Beban Kerja Mental dengan Metode Nasa Tlx pada Operator Kargo di PT. Dharma Bandar Mandala (PT. Dbm). *Industrial Engineering Online Journal*, *5*(4)

Pramasari, A. L., Widjasena, B., Kurniawan, B., & Suroto, S. (2017). Analisis Tingkat Risiko Kelelahan Pada Masinis Commuter Line Rute Bogor-Jakarta Kota. *Jurnal Kesehatan Masyarakat (e-Journal)*, *5*(2), 93-99

Fatonah, Zarah Alifianidah, (2019). *Analisis Pengaruh Kelelahan Kerja Terhadap Keselamatan Kerja Petugas di Bagian Ruas Ruang Mekanik Dan Elektrik Depo Kereta Surabaya Pasar Turi.* Tugas Akhir. Akademi Perkeretaapian Indonesia Madiun

Hariyati, M. (2011). Pengaruh beban kerja terhadap kelelahan kerja pada pekerja linting manual di PT. *Djitoe Indonesia Tobacco Surakarta. Skripsi. Universitas Sebelas Maret Surakarta*

Damayanti, Kristiana Asih dan Cantikawati, Yuke. 2012. "Pengukuran Beban Kerja Mental Masinis Kereta Api Rute Jarak Jauh (Studi Kasus Pada PT KAI DAOP 2)". Simposium Nasional RAPI XI FT UMS-2012, ISSN: 1412-9612

Muslimah, E., & Hastuti, B. D. (2017). Evaluasi Beban Kerja Mental Masinis Kereta Api Prameks dengan Metode RNASA-TLX (Studi Kasus: PT. KAI DAOP 6 YOGYAKARTA). In *Prosiding Seminar dan Konferensi Nasional IDEC*

Ramadhan, R., Tama, I. P., & Efranto, R. Y. (2014). Analisa Beban Kerja Dengan Menggunakan Work Sampling Dan Nasa-Tlx Untuk Menentukan Jumlah Operator (Studi Kasus: Pt Xyz). *Jurnal Rekayasa dan Manajemen Sistem Industri*, *2*(5), p. 926-973

Puteri, R. A. M., & Sukarna, Z. N. K. (2017). Analisis Beban Kerja Dengan Menggunakan Metode CVL Dan NASA-TLX Di PT. ABC. *Spektrum Industri*, *15*(2), 211-221

Indonesia, Pemerintah. Peraturan Nomor 56 Tahun 2009 tentang Penyelenggaraan Perkeretaapian. *Kementerian Perhubungan, Jakarta.*

Siregar, S. (2013). Statistik parametrik untuk penelitian kuantitatif. *Jakarta: Bumi Aksara*

Yeni, Y., Daulay, I.N., & Paramitha, A. (2018). Analisis Ergonomi Beban Kerja Fisik Terhadap Stres dan Kinerja Karyawan PT. Rifansi Dwi Putra Duri. *Journal Online Mahasiswa Universitas Riau*. 1 (1). 1-15.