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Testing Mental Workload with Applying the NASA-TLX Method

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Abstract
The demands of production targets often make the operators get high pressure and cause mental workload. Decreasing performance of workers might be from the excessive mental burden. A test of mental work load was conducted at London Sumatera Indonesia Company (LSI Co) in North Sumatra of Indonesia. It aimed at evaluating the workload experienced by the production floor operator With National Aeronautics and Space Administration Task Load Index (NASA-TLX) method. It used six workload indicators, namely mental demand, physical demand, temporal demand, performance, effort and frustration level and work sampling. The test with NASA-TLX was for operators on the production floor. The study result revealed that the highest workload happened to reception station at 82.33% (whinch rope whinch operators). Data result shows that productivity time is 87.1% - 91,3%. The high load of work on the operator, so it needs to be given a suggestion of improvement that is the provision of additional rest time on the sidelines of work time, operator rotation, shift arrangements and individual operator's work habits when working.

Keywords: *Mental; workload; performances; NASA-TLX; palm oil company;*

1. Introduction

An overload problem in the processing units of companies can reduce the productivity even may harm the workers. Workload of laborers needs to calculate proportionately, Conversely, if the ability of workers is lower than the demands of work, it will appear excessive fatigue. It is necessary to conduct a research to know the mental work load and productivity of the operator's work on the production floor. The human body is designed to perform daily work activities. The presence of muscle mass that weighs almost more than half the body weight is allowing us to be able to move the body and do the job. Work means the body will receive the burden from outside the body. In other words every worker is a burden to the concerned (Hertzum, 2010). The burden can be either physical or mental burden (Galy et al, 2012). Although it cannot be separated, it can still be distinguished from work with physical dominance and work with mental dominance. This physical and mental activity has consequences, namely the emergence of workload (Mohammadi, 2015).

This study was conducted to seek the data of workload of laborers in London Sumatra Company of Indonesia. In the Annual Report of LONSUM (2014), this company has the processing of Fresh Fruit Bunch (FFB) or fresh fruit bunches into Crude Palm Oil (CPO) and Palm Kernel (PK) (Julia, 2010). Lonsum also manages oil palm plantations under the plasma program. The palm oil mills facilities in Sumatra and Kalimantan have a combined fresh fruit bunch (FFB) processing capacity of 2.4 million tons per annum. Lonsum also operates several rubber processing facilities, a cocoa factory and a tea factory (Annual Report LONSUM, 2015).

A test of workload can be measured based on the National Aeronautics and Space Administration Task Load Index (NASA-TLX) method and sampling work. NASA-TLX is the method used for analyzing the mental workload faced by workers who must perform various activities in their work

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(Casner and Gore, 2010). NASA-TLX is an effective technique for assessing relative workload levels (Eitrheim and Fernandes, 2016). The NASA Task Load Index uses six dimensions to assess mental workload: mental demand, physical demand, temporal demand, performance, effort, and frustration (Rubio et al, 2004). Work sampling method is a workload measurement method that aims to determine the percentage of productive time of a worker during working hours under normal circumstances.

2. Research Method

The study was a survey research on the operators of London Sumatra Enterprise (Stevanov et al, 2015). It was conducted with the spread of NASA-TLX and Work Sampling questionnaires to the workers concerned. The NASA-TLX questionnaire consists of two parts: the selection of the most dominant indicators and rating. As for the work sampling questionnaire begins from determining the activities that include work and idle. This research was conducted for 5 working days starting on shift I at 08.00 a.m until 04.00 p.m and shift II at 04.00 p.m until 12.00 a.m. The study was conducted for 1 month of October to November of 2016 at LSI Com Tbk, which located in the Turangie Palm Oil Mill of North Sumatra of Indonesia.

3. Results and Discussion

In this study the data collected are productivity measurement (work sampling), mental workload measurement (NASA-TLX), Correlation Analysis and Regression, Measurement of Productivity (work sampling) (Dendukuri and Reinhold, 2005). The calculation of productive time employees performed to determine the percentage of productive time each employee so that it can know the average percentage of time that the operator used to work during working hours.

$$\text{Percentage of productive time} = \frac{\text{Number of Observations} - \text{Activity}}{\text{Number of Observations}} \times 100\%$$

Based on the above formula, calculating the percentage of productive time for *Weighing Bridge Operator* on *Reception Station* on the 1st day is:

$$\text{1st day} = \frac{48 - 5}{48} \times 100\% = 0{,}896$$

Recapitulation of productive time percentage of each operator for each station based on work sampling observation can be seen in Table 1.

Table 1. Recapitulation percentage of productive time

No	Name of Respondent	Productive (%)					Average
		1st day	2nd day	3rd day	4th day	5th day	
1	Kasianto	0,896	0,917	0,875	0,938	0,875	0,900
2	Suhendra	0,875	0,896	0,875	0,896	0,875	0,883
3	Izal	0,854	0,896	0,938	0,896	0,875	0,892
4	Sugianto	0,875	0,917	0,896	0,917	0,875	0,896
5	Erpin Sembiring	0,896	0,875	0,917	0,875	0,854	0,883
6	Sinar Yadi	0,875	0,917	0,875	0,917	0,896	0,896
7	Suratman	0,938	0,917	0,896	0,917	0,896	0,913
8	Misdi Wijaya	0,875	0,854	0,896	0,875	0,896	0,879
9	Ali Sayuti	0,854	0,875	0,917	0,833	0,875	0,871
10	Bassar	0,875	0,854	0,896	0,833	0,896	0,871
11	Tekat Sitepu	0,896	0,875	0,917	0,875	0,896	0,892
12	Samsulianto	0,875	0,917	0,854	0,875	0,896	0,883
13	Edi Suprianto	0,917	0,875	0,875	0,854	0,896	0,883
14	Ariadi	0,875	0,896	0,875	0,917	0,875	0,888

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15	Surip	0,875	0,854	0,917	0,896	0,875	0,883
16	Paiman	0,917	0,896	0,896	0,917	0,875	0,900
17	Suwandi	0,896	0,875	0,875	0,854	0,896	0,879
18	Wagiman	0,875	0,875	0,854	0,896	0,979	0,896
19	Edy Santoso	0,917	0,896	0,875	0,896	0,875	0,892
20	Antoni Tarigan	0,854	0,875	0,896	0,875	0,854	0,871
21	Ponirin	0,875	0,854	0,896	0,854	0,896	0,875
22	Peprianto Matsur	0,875	0,896	0,875	0,896	0,854	0,879
23	Edy S Sebayang	0,875	0,854	0,896	0,875	0,917	0,883
24	Suardi	0,938	0,917	0,875	0,896	0,917	0,908
25	Ridwan	0,896	0,875	0,917	0,917	0,896	0,900
26	Bambang Nurdiyansyah	0,875	0,917	0,854	0,875	0,896	0,883
27	M. Affan	0,854	0,875	0,833	0,896	0,896	0,871
28	Jamunar Musliadi	0,875	0,854	0,896	0,917	0,875	0,883
29	Musa Ginting	0,896	0,875	0,917	0,896	0,875	0,892
30	Heri Nurianto	0,917	0,875	0,917	0,896	0,875	0,896
31	Misdi	0,896	0,875	0,854	0,917	0,854	0,879
32	Edi B	0,875	0,854	0,896	0,917	0,875	0,883
33	Alamsyah Arman	0,854	0,896	0,833	0,875	0,896	0,871
34	Junaidi	0,875	0,854	0,896	0,875	0,896	0,879
35	Supriadi	0,875	0,917	0,854	0,875	0,896	0,883
36	Ponimin	0,875	0,917	0,854	0,875	0,833	0,871

3.1.Test Data Uniformity

Test data uniformity is done to determine whether the data collected is uniform or not (Vranić and Uzunović, 2008). It is marked in the absence of data out of control. The data uniformity test in this research is done at 95% confidence level and level of accuracy equal to 5%. The formula used to test data uniformity is as follows:

$$\text{UCL} = \bar{p} + 2\sqrt{\frac{\bar{p}\,(1-\bar{p})}{n}}$$

$$\text{LCL} = \bar{p} - 2\sqrt{\frac{\bar{p}\,(1-\bar{p})}{n}}$$

Where:

UCL = Upper Control Limit

LCL = Lower Control Limit

$\bar{p}$ = Average productivity of operators

n = Average number of observations per working day

Based on the formula above, the result of uniform data calculation on Reception Station for Weighing Bridge Operator is as follows:

$$\text{UCL} = 0{,}900 + 2\sqrt{\frac{0{,}900\,(1-0{,}900)}{48}} = 1{,}006$$

$$\text{LCL} = 0{,}900 - 2\sqrt{\frac{0{,}900\,(1-0{,}900)}{48}} = 0{,}794$$

of data seen in figure 2.

Figure 2. Map Control of *Weighing Bridge* Operator

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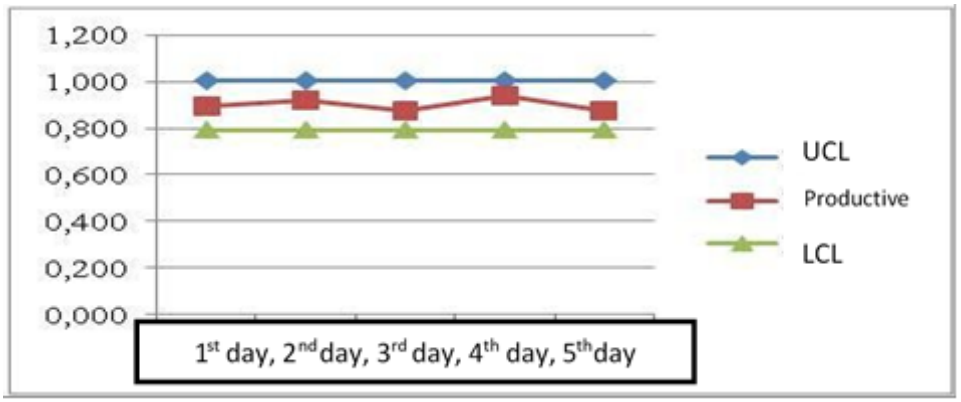

Recapitulation of uniform data test results for all operators can be seen in Table 2.

Table 2. Recapitulation of Data Uniform Test Result

No	Name of Respondent	p	BKA	BKB	Information
1	Kasianto	0,900	1,006	0,794	Uniform
2	Suhendra	0,883	0,997	0,770	Uniform
3	Izal	0,892	1,002	0,782	Uniform
4	Sugianto	0,896	1,004	0,788	Uniform
5	Erpin Sembiring	0,883	0,997	0,770	Uniform
6	Sinar Yadi	0,896	1,004	0,788	Uniform
7	Suratman	0,913	1,012	0,813	Uniform
8	Misdi Wijaya	0,879	0,994	0,764	Uniform
9	Ali Sayuti	0,871	0,989	0,752	Uniform
10	Bassar	0,871	0,989	0,752	Uniform
11	Tekat Sitepu	0,892	1,002	0,782	Uniform
12	Samsulianto	0,883	0,997	0,770	Uniform
13	Edi Suprianto	0,883	0,997	0,770	Uniform
14	Ariadi	0,888	0,999	0,776	Uniform
15	Surip	0,883	0,997	0,770	Uniform
16	Paiman	0,900	1,006	0,794	Uniform
17	Suwandi	0,879	0,994	0,764	Uniform
18	Wagiman	0,896	1,004	0,788	Uniform
19	Edy Santoso	0,892	1,002	0,782	Uniform
20	Antoni Tarigan	0,871	0,989	0,752	Uniform
21	Ponirin	0,875	0,992	0,758	Uniform
22	Peprianto Matsur	0,879	0,994	0,764	Uniform
23	Edy S Sebayang	0,883	0,997	0,770	Uniform
24	Suardi	0,908	1,010	0,806	Uniform
25	Ridwan	0,900	1,006	0,794	Uniform
26	Bambang Nurdiyansyah	0,883	0,997	0,770	Uniform
27	M. Affan	0,871	0,989	0,752	Uniform
28	Jamunar Musliadi	0,883	0,997	0,770	Uniform
29	Musa Ginting	0,892	1,002	0,782	Uniform
30	Heri Nurianto	0,896	1,004	0,788	Uniform

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31	Misdi	0,879	0,994	0,764	Uniform
32	Edi B	0,883	0,997	0,770	Uniform
33	Alamsyah Arman	0,871	0,989	0,752	Uniform
34	Junaidi	0,879	0,994	0,764	Uniform
35	Supriadi	0,883	0,997	0,770	Uniform
36	Ponimin	0,871	0,989	0,752	Uniform

3.2.Data Sufficiency Test

To find out whether the data collected has been sufficient or not, then it is performed the test data adequacy. If N '> N then the data is not sufficient so it should be observed again until the data has been sufficient. The formula used for the test data sufficiency is as follows:

$$N' = \frac{\frac{k^2}{s}1-p}{p}$$

N' = Number of observations to be taken for work sampling
s = The desired level of accuracy (decimal form)
k = The index price of magnitude depends on the level of confidence taken (obtained from the normal distribution table)
p = Average employee productivity (decimal form)

Based on the formula above then the results of calculation test data sufficiency for *Reception Station* at *Weighing Bridge Operator* (Commonwealth of Australia, 2008) is as follows:

$$N' = \frac{\frac{2^2}{0.05}1-0.900}{0.900}$$

Based on the above calculation, it can be concluded that the value of N '<N or 177,778 <240 then the data is sufficient. As for the recapitulation of the test data adequacy for all operators, it can be seen in Table 3.

Table 3. Recapitulation of Observation Data Adequacy Test Result

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No	Name of Respondent	$\bar{p}$	N	N'	Information
1	Kasianto	0,900	240	177,778	Adequate Data
2	Suhendra	0,883	240	211,321	
3	Izal	0,892	240	194,393	Adequate Data
4	Sugianto	0,896	240	186,047	Adequate Data
5	Erpin Sembiring	0,883	240	211,321	
6	Sinar Yadi	0,896	240	186,047	Adequate Data
7	Suratman	0,913	240	153,425	Adequate Data
8	Misdi Wijaya	0,879	240	219,905	
9	Ali Sayuti	0,871	240	237,321	Adequate Data
10	Bassar	0,871	240	237,321	Adequate Data
11	Tekat Sitepu	0,892	240	194,393	
12	Samsulianto	0,883	240	211,321	Adequate Data
13	Edi Suprianto	0,883	240	211,321	
14	Ariadi	0,888	240	202,817	Adequate Data
15	Surip	0,883	240	211,321	Adequate Data
16	Paiman	0,900	240	177,778	
17	Suwandi	0,879	240	219,905	Adequate Data
18	Waginan	0,896	240	186,047	Adequate Data
19	Edy Santoso	0,892	240	194,393	
20	Antoni Tarigan	0,871	240	237,321	Adequate Data
21	Ponirin	0,875	240	228,571	Adequate Data
22	Peprianto Matsur	0,879	240	219,905	
23	Edy S Sebayang	0,883	240	211,321	Adequate Data
24	Suardi	0,908	240	161,468	Adequate Data
25	Ridwan	0,900	240	177,778	
26	Bambang Nurdiyansyah	0,883	240	211,321	Adequate Data
27	M. Affan	0,871	240	237,321	Adequate Data
28	Jamunar Musliadi	0,883	240	211,321	
29	Musa Ginting	0,892	240	194,393	Adequate Data
30	Heri Nurianto	0,896	240	186,047	
31	Misdi	0,879	240	219,905	Adequate Data
32	Edi B	0,883	240	211,321	Adequate Data
33	Alamsyah Arman	0,871	240	237,321	
34	Junaidi	0,879	240	219,905	Adequate Data
35	Supriadi	0,883	240	211,321	Adequate Data
36	Ponimin	0,871	240	237,321	

3.3.Measurement of Mental Workload (NASA-TLX)

After completing the data from the questionnaire, then the calculation is done from here with this:

WWL = weight x *Rating*

Average of WWL = $\frac{WWL}{15}$

WWL average calculation results are then converted into four categories can be seen in the table 4 below:

Table 4. Classification of Mental Workload Scale

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Category	Scale
Low	10 – 33
Medium	34 – 56
High	57 – 79
Very High	80 - 100

The calculation of the mental workload for the Weighing Bridge operator is as follows:

WWL (MD) = 4 x 85
= 2 x 50
= 340

Recapitulation of calculation of mental workload of operator Shift I and Shift II by using NASA-TLX method can be seen in Table 5.

Table 5. Recapitulation of Shift I and Shift II Operator Mental Workloads

No.	Name	WWL	Average of WWL
1	Kasianto	935	62,33
2	Suhendra	1040	69,33
3	Izal	880	58,67
4	Sugianto	910	60,67
5	Erpin Sembiring	1195	79,67
6	Sinar Yadi	1075	71,67
7	Suratman	895	59,67
8	Misdi Wijaya	915	61,00
9	Ali Sayuti	1125	75,00
10	Bassar	1115	74,33
11	Tekat Sitepu	990	66,00
12	Samsulianto	820	54,67
13	Edi Suprianto	965	64,33
14	Ariadi	930	62,00
15	Surip	1040	69,33
16	Paiman	1000	66,67
17	Suwandi	995	66,33
18	Wagiman	1010	67,33
19	Edy Santoso	910	60,67
20	Antoni Tarigan	960	64,00
21	Ponirin	890	59,33
22	Peprianto Matsur	1235	82,33
23	Edy S Sebayang	1095	73,00
24	Suardi	950	63,33
25	Ridwan	1035	69,00
26	Bambang Nur.	1085	72,33
27	M. Affan	1125	75,00
28	Jamunar Musliadi	1055	70,33
29	Musa Ginting	975	65,00
30	Heri Nurianto	975	65,00
31	Misdi	915	61,00
32	Edi B	1030	68,67
33	Alamsyah Arman	1035	69,00
34	Junaidi	1075	71,67
35	Supriadi	1080	72,00
36	Ponimin	1055	70,33

3.4.Correlation Analysis

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By using the rank spearman correlation method, it can be seen the correlation or the relationship between mental workload variable (WWL) with variable 6 NASA-TLX indicator which at once can answer the main problem in this research. NASA-TLX indicator in this research is independent variable which becomes dependent variable is mental work load (WWL). Hypothesis in this research are:

Ho: There is no relationship between the NASA-TLX indicators and the mental workload (WWL) operator on the production floor of LSI Com Tbk, Turangie POM.

Ha: There is a relationship between the NASA-TLX indicator and the mental workload (WWL) operator on the production floor of LSI Com Tbk, Turangie POM.

The test used two-sided test with significance level α = 5%. With the testing criteria: Ho is accepted if significance> 0.05 Ho is rejected if significance <0.05
The value of the correlation coefficient (r) describes the strength of the relationship, the categorization interval of the correlational correlation power.

Table 6. Categorization interval of strength of correlation relationship

Score	Information
0 – 0,199	Very Low
0,20 – 0,399	Low
0,40 – 0,599	Medium
0,60 – 0,799	High
0,80 – 1,0	Very High

Correlations

			MD	PD	TD	OP	EF	FR	WWL
Spearman's rho	MD	Correlation Coefficient	1,000	-,493**	,039	-,131	-,008	-,411*	,217
		Sig. (2-tailed)	.	,002	,819	,447	,964	,013	,204
		N	36	36	36	36	36	36	36
	PD	Correlation Coefficient	-,493**	1,000	,460**	,541**	,432**	,743**	,875**
		Sig. (2-tailed)	,002	.	,005	,001	,009	,000	,000
		N	36	36	36	36	36	36	36
	TD	Correlation Coefficient	,039	,460**	1,000	,445**	,649**	,359*	,707**
		Sig. (2-tailed)	,819	,005	.	,007	,000	,032	,000
		N	36	36	36	36	36	36	36
	OP	Correlation Coefficient	-,131	,541**	,445**	1,000	,182	,560**	,712**
		Sig. (2-tailed)	,447	,001	,007	.	,289	,000	,000
		N	36	36	36	36	36	36	36
	EF	Correlation Coefficient	-,008	,432**	,649**	,182	1,000	,085	,539**
		Sig. (2-tailed)	,964	,009	,000	,289	.	,622	,001
		N	36	36	36	36	36	36	36
	FR	Correlation Coefficient	-,411*	,743**	,359*	,560**	,085	1,000	,712**
		Sig. (2-tailed)	,013	,000	,032	,000	,622	.	,000
		N	36	36	36	36	36	36	36
	WWL	Correlation Coefficient	,217	,875**	,707**	,712**	,539**	,712**	1,000
		Sig. (2-tailed)	,204	,000	,000	,000	,001	,000	.
		N	36	36	36	36	36	36	36

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

	Sig. (2-tailed)	,819	,005	.	,007	,000	,032	,000
	N	36	36	36	36	36	36	36
OP	Correlation Coefficient	-,131	,541**	,445**	1,000	,182	,560**	,712**
	Sig. (2-tailed)	,447	,001	,007	.	,289	,000	,000
	N	36	36	36	36	36	36	36
EF	Correlation Coefficient	-,008	,432**	,649**	,182	1,000	,085	,539**
	Sig. (2-tailed)	,964	,009	,000	,289	.	,622	,001
	N	36	36	36	36	36	36	36
FR	Correlation Coefficient	-,411*	,743**	,359*	,560**	,085	1,000	,712**
	Sig. (2-tailed)	,013	,000	,032	,000	,622	.	,000
	N	36	36	36	36	36	36	36
WWL	Correlation Coefficient	,217	,875**	,707**	,712**	,539**	,712**	1,000
	Sig. (2-tailed)	,204	,000	,000	,000	,001	,000	.
	N	36	36	36	36	36	36	36

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

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correl able 7

Sig value. (2-tailed) output above 0.01 for the indicator (PD, TD, OP, EF and FR), meaning less than 0.05 (p = 0,000 <0.05). In accordance with the test criteria, if the significance value is less than 0.05 then Ho is rejected and Ho is accepted for the indicator (MD). Ho in this study is, "There is no relationship between NASA-TLX indicator and the mental workload (WWL) operator on the production floor of LSI Com Tbk, Turangie POM. It is Rejected. While Ha in this research is, "There is a relationship between the NASA-TLX indicator and the mental workload (WWL) operator on the production floor of LSI Com Tbk, Turangie POM. It is Accepted.

Meanwhile, the correlation coefficient (r) between the NASA-TLX indicator variable (MD = 0.707, OP = 0.712, FR = 0.712) the closeness of the relationship including strong, (PD = 0.875) the closeness of the relationship is very strong, if interpreted by interval categorization strength correlation relationship.

3.5.Regression Analysis

This analysis is to know the direction of relationship between independent variables and dependent variable whether positive or negative and to predict the value of the dependent variable if the value of the independent variable increases or decreases

Table 8. Regression Test Results

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Variables Entered/Removed[a]

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-2,919	4,008		-,728	,472
	MD	,145	,038	,203	3,827	,001
	PD	,180	,030	,411	6,030	,000
	TD	,231	,061	,230	3,812	,001
	OP	,202	,039	,254	5,126	,000
	EF	,176	,048	,191	3,692	,001
	FR	,139	,033	,268	4,174	,000

a. Dependent Variable: WWL

From result of regression test of linear obtained R 0,977. The R value means that 97.7% of the mental workload is affected by the NASA-TLX indicator (MD, PD, TD, OP, EF, and FR), while 2.3% is influenced by other factors.

3.6.Analysis of NASA-TLX Workload

Relations and Work Sampling

The results of NASA-TLX processing and overall work sampling can be seen in Table 9.

Table 9. Results of NASA-TLX Data Processing and Work Sampling

No	Name of Respondent	Average of WWL %	The Most Influential Indicators	Productive Time Work Sampling Results	Allowance
1	Kasianto	62,33	*Physical Demand*	90,0%	10
2	Suhendra	69,33	*Mental Demand*	88,3%	10
3	Izal	58,67	*Temporal Demand*	89,2%	10
4	Sugianto	60,67	*Effort*	89,6%	10
5	Erpin Sembiring	74,67	*Physical Demand*	88,3%	10
6	Sinar Yadi	71,67	*Physical Demand*	89,6%	10
7	Suratman	59,67	*Mental Demand*	91,3%	10
8	Misdi Wijaya	61,00	*Temporal Demand*	87,9%	10
9	Ali Sayuti	75,00	*Physical Demand*	87,1%	10
10	Bassar	74,33	*Physical Demand*	87,1%	10
11	Tekat Sitepu	66,00	*Physical Demand*	89,2%	10
12	Samsulianto	54,67	*Effort*	88,3%	10
13	Edi Suprianto	64,33	*Physical Demand*	88,3%	10

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14	Ariadi	62,00	*Physical Demand*	88,8%	10
15	Surip	69,33	*Physical Demand*	88,3%	10
16	Paiman	66,67	*Physical Demand*	90,0%	10
17	Suwandi	66,33	*Physical Demand*	87,9%	10
18	Wagiman	67,33	*Physical Demand*	89,6%	10
19	Edy Santoso	60,67	*Mental Demand*	89,2%	10
20	Antoni Tarigan	64,00	*Effort*	87,1%	10
21	Ponirin	59,33	*Physical Demand*	87,5%	10
22	Peprianto Matsur	78,67	*Physical Demand*	87,9%	10
23	Edy S Sebayang	73,00	*Physical Demand*	88,3%	10
24	Suardi	63,33	*Mental Demand*	90,8%	10
25	Ridwan	69,00	*Mental Demand*	90,0%	10
26	Bambang Nurdiyansyah	72,33	*Physical Demand*	88,3%	10
27	M. Affan	75,00	*Physical Demand*	87,1%	10
28	Jamunar Musliadi	70,33	*Physical Demand*	88,3%	10
29	Musa Ginting	65,00	*Temporal Demand*	89,2%	10
30	Heri Nurianto	65,00	*Physical Demand*	89,6%	10
31	Misdi	61,00	*Physical Demand*	87,9%	10
32	Edi B	68,67	*Physical Demand*	88,3%	10
33	Alamsyah Arman	69,00	*Physical Demand*	87,1%	10
34	Junaidi	71,67	*Physical Demand*	87,9%	10
35	Supriadi	72,00	*Physical Demand*	88,3%	10
36	Ponimin	70,33	*Physical Demand*	87,1%	10

From Table 9, it can be seen that there is a difference between work sampling observation and mental workload according to NASA-TLX. This is because the operator has different capabilities in the face of each job and also requires different concentrations in completing the work.

The mental burden in the work environment is influenced by task demands, external environmental factors and years of service experience. Task demands operators work with high concentration levels, time pressure completion and perform monotonous work activities. The highest mental work load is found in *Whinch Rope Whinch Operator* (*Reception Station*) shift II of 82.33%. Such high workloads can be attributable to the large demands in the completion of the tasks to which they are responsible. The amount of physical activity such as pushing, pulling, rotating, controlling, running large enough that they have to spend in the completion of these tasks can be a factor causing the high mental workload. So the productive time that the operator uses to complete his tasks is 87, 9% and non-productive by 12.1%. In Press Operator shift I have the lowest mental work load of 54.67% and the most influential indicator is physical demand in completing the job given by the company, whereas for productive time is high that is 88.3%. The operator considers that the time given is sufficient in the completion of the work.

7. Conclusion

Based on the NASA-TLX analysis there are different observations for each operator of the job. *Whinch Rope Whinch Operator's* working load on Reception Station shift II of 82.33% is included on a very high scale. The high mental workload is caused due to the high demand in the completion of tasks that are the responsibility of the operator. At the *Whinch Rope Whinch Operator* requires high physical activity (Physical Demand dimension) such as pushing, pulling, twisting, controlling, running in

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doing its work. While the low mental work load experienced by the Press Operator on the Pressing Station shift II is 54.67%. Based on work sampling measurement results, the largest percentage of productive time owned by operator Sterilizer Attendants, which is equal to 91.3% and the lowest, is owned by the operator, which is 87.1%. Based on the allowance of 10%, the time used by the operator to work is 90% of 8 working hours per day.

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