Assessment and the Difference of Mental Workload between Work from Home (WFH) and Work form Office (WFO) Using NASA-TLX (Case Study in PT KIC)

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Abstract

The world is currently impacted by novel coronavirus disease (COVID-19). The government issued a policy to control the spread of the Covid-19 virus, this policy is to limit the activity in public areas. Some industries applied the policy to do work from home (WFH) and work from the office (WFO) as well as PT KIC does. The application of this work system has an impact on the mental workload experienced by employees in PT KIC. This study aims to determine the mental workload factor during WFH and WFO and to analyze the difference of Working Workload (WWL) at the marketing department in PT KIC. The method used is NASA-TLX, and the difference of WWL used the Wilcoxon test. The NASA-TLX uses six indicators namely mental demand, physical demand, temporal demand, own performance, effort, and stress level (frustration). The results obtained from the NASA-TLX method are that the biggest mental workload factor during WFH is performance and the biggest mental workload factor during WFO is effort, based on the Wilcoxon test results value of average WWL $z=-3.296$, $p=0.001$ ($p<0.05$). There was a significant difference in the measurement results of the average WWL of employees during WFH and WFO.

Keywords
Mental Workload, NASA-TLX, WFH, WFO, Covid-19.

1. Introduction

Virus of Covid-19 was found first in Wuhan, China in December 2019. The Virus was spread to the almost around the world including Indonesia, with the first case of Covid-19 in Indonesia was found in early March 2020 (Nuraini 2020). Therefore, WHO decided this condition became pandemic of Covid-19 (Utomo 2020). Pandemic Covid-19 in Indonesia became worst and curve of case has been increasing sharply. To prevent the spread of Covid-19 virus, Indonesia Government quickly working to develop and implement the appropriate prevention policies. The government officially issued a large-scale social distancing policy or PSBB (www.setkab.go.id 2020). Furthermore, the PSBB issued has affected to the world of work, all offices except health, food and logistic sectors apply a work from home (WFH) policy. On the other hand, industry sector supposes to be maintaining its business continuity, where not all work can be done from home, so they apply the work from office system (WFO) and the work from home system (WFH) alternately.

The WFH and WFO work systems are also applied to PT. KIC, PT KIC is a company in the chemical industry sector, which produced surfactants in Indonesia. Changes in the work system have an effect on the perceived workload of some employees, where when the workload is less because not all work can be done at home. This of course makes work when WFO increases due to delays in some work during WFH.

The role of ergonomics ensures that every worker does not feel the workload overload or workload underload, while workload overload may decrease productivity, decreased concentration, and work stress. While the workload underload may cause demotivation. The workload must be in accordance with the capacity of each worker in order to achieve effective, comfortable, safe, healthy and efficient working conditions. In the other hand, Changes in the WFH and WFO work systems cause changes in the level of work stress felt by workers, apart from the changing work

system, the effects of the Covid-19 pandemic also affect the mental health of workers, job insecurity, anxiety, depression, and post-traumatic trauma disorders (PTSD) (Giorgi et al. 2020).

Mental workload can be measured by subjective measurement, subjective measurement was broadly used to assess mental workload because non-intrusive and easy implementation. One of the tool subjective measurement of mental workload is NASA-TLX (National Aeronautics and Space Administration task load index) (Hart and Staveland 1988). NASA-TLX has known as the tool that have sensitivity, selectivity, diagnostic capabilities, reliability, low intrusiveness and ease of implementation (Rubio et al. 2004).

1.1 Objectives

During pandemic Covid-19 some systems of work have changed that was system WFH and WFO was applied to PT KIC work system. The objective of this research is to determine mental workload of employee PT KIC during WFH and WFO and to determine the difference of mental workload between WFH and WFO working system.

2. Literature Review

2.1 Mental Workload

Research on mental workloads has been carried out in various aspects of work (Habibi et al. 2015) (Afma 2016)(Loft et al. 2007). When doing work, someone will feel too busy, this job is very difficult to do, cannot deal with sudden events. This feeling occurs when demand exceeds supply, supply is the brain's limitation in processing information, while demand is the amount of task that must be completed. the relationship between supply-demand is associated with a person's mental workload (Wickens et al. 2013).

Wickens et al. (2013) said mental workload can be measured with the three way: behavior, secondary task, and subjective measure. Behavior can change since demand increases and cognitive capacity decreases, changes in behavior can be seen in reduced frequency and average control speed. Although secondary task has high of fidelity, the application secondary task to assess mental workload may be bias and intrusive for some case. Subjective measure is widely used to assess mental workload. This measurement uses a unidimensional or multidimensional scale that is assessed on a rating scale. This rating scale shows a person's perceived workload. Unidimensional tool for subjective measurement is RSME (rating scale mental effort) (Widyanti et al. 2013), multidimensional tool for subjective measurement are SWAT (Subjective Assessment Technique) (Reid and Nygren 1988) and NASA-TLX (Hart and Staveland 1988).

2.2 NASA-TLX

NASA-TLX is multidimensional scale to subjectively assess mental workload, developed by Sandra G. Hart from NASA research center and Lowell E. Steveland in 1988 NASA-TLX assess mental workload by combination of six workload-related factors there were mental demand (MD), physical demand (PD), temporal demand (TD), performance (OP), effort (EF) and frustration (FR) level (Hart and Staveland 1988). NASA-TLX have been used to assess mental workload of various job such as air traffic control, civilian, military cockpits, automobile drivers, medical profession, users of computers, portable technology such as cellphones (Hart 2006).

In line with this research, similar research has been conducted to assess mental workload to employee of HRO & GA using NASA-TLX, the research showed that employee have high workload and affected to the internal customer satisfaction (Rakhmawati and Susanto 2018). Another research to assess mental workload using NASA-TLX to the employee in University showed that 84% of employee have high mental workload, 8% moderate mental workload (Azemil and Wahyuni 2016).

3. Method

Respondents of this research was conducted to the 14 employees whose work in marketing, purchasing, and finance department in PT KIC. The typical work of those department was providing the need of customer and vendor. While during pandemic covid-19, they work one day WFH and one day WFO, vice versa.

The subjective workload of the respondents was investigated using NASA-TLX questionnaire, they filled the questionnaire after WFH and WFO. The respondents filled the questionnaire with two stage, the first stage they

measure the mental workload using rating of the six dimensions of 1 to 100 based on the working condition while WFH and WFO. Second stage they determined the most significance of the source of workload while working WFH and WFO by choose 15 paired of source of workload.

The data is processed by calculating the results of the rating of six dimensions (rating) and the results of pairwise comparisons (weight). Product of each six dimension is obtained form rating multiply by weight. The Product of working workload (WWL) is obtained from the sum of rating times weight. Average WWL is obtained from product WWL divided by 15. From this stage we get the mental workload data from six dimensions and the average WWL of the respondents during WFH and WFO.

The collected data were analyzed using SPSS 21. The descriptive statistical table were used to describe the workload: mean, standard deviation (SD), minimum and maximum value. The box-and-whisker plot were used to graphically described the characterization and distribution of data. To investigate the different of mental workload between WFH and WFO Wilcoxon test were used.

4. Data Collection

14 respondents have been filled NASA-TLX questionnaire after they WFH and WFO, results from first stage of NASA-TLX questionnaire (rating) from six dimension during respondent WFH and WFO are showed in table 1 and table 2 respectively. Result from second stage of NASA-TLX questionnaire (weight) during WFH and WFO are showed in table 3 and table 4 respectively.

Table 1. NASA-TLX rating during WFH

Workload Factor	Respondent													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
MD	45	20	40	30	45	20	20	30	25	50	30	40	30	40
PD	20	10	20	20	30	20	10	20	20	10	25	10	20	10
TD	45	20	30	60	65	10	10	20	60	10	30	40	25	25
OP	70	60	65	55	65	50	40	80	60	65	75	80	85	75
EF	60	30	65	55	60	30	35	75	60	60	75	75	80	75
FR	30	25	20	50	60	10	25	30	30	40	30	20	30	25

Table 2. NASA-TLX rating during WFO

Workload Factor	Respondent													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
MD	70	75	40	60	50	30	55	60	70	70	75	80	75	75
PD	20	60	40	80	40	50	60	30	30	60	65	40	35	25
TD	70	80	30	50	60	50	60	70	45	65	50	70	70	75
OP	80	80	75	85	85	75	70	85	75	75	80	70	65	75
EF	80	75	75	85	80	60	70	90	75	80	75	80	70	75
FR	45	50	25	50	40	40	60	35	65	30	40	35	40	55

Table 3. NASA-TLX weight during WFH

Workload Factor	Respondent													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
MD	3	2	3	3	2	3	2	3	2	4	2	4	3	3
PD	0	0	0	0	0	1	1	1	0	1	0	0	0	0
TD	3	3	4	5	5	1	0	1	5	0	2	2	1	4
OP	4	2	3	2	2	5	5	5	3	3	4	5	5	3
EF	3	3	2	2	2	4	4	3	3	4	4	3	3	4
FR	2	5	3	3	4	1	3	2	2	3	3	1	3	1

Table 4. NASA-TLX weight during WFO

Workload Factor	Respondent													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
MD	4	3	3	2	2	0	1	2	3	3	3	4	4	3
PD	0	1	2	4	0	4	4	0	0	3	3	1	0	0
TD	2	4	2	0	4	3	1	3	2	1	2	3	3	4
OP	2	4	4	4	4	4	2	4	3	3	4	2	3	3
EF	5	2	4	4	4	3	3	5	3	5	3	5	4	3
FR	2	1	0	1	1	1	4	1	4	0	0	0	1	2

5. Results and Discussion

5.1 Numerical Results

We calculate product of six dimension and average WWL using data from table 1 until table 4. Then, product of six dimension and average WWL obtained during WFH and WFO were processed with descriptive statistics, the results of descriptive statistical processing for respondents during WFH and WFO are presented in table 5 and table 6 respectively.

Table 5. Product NASA-TLX of employee during WFH

Workload Dimension	Mean	SD	Min.	Max.
Mental Demand	96.0	47	40	200
Physical Demand	4.3	7.6	0	20
Temporal Demand	118	119.5	0	325
Performance	243.6	105	110	425
Effort	185.7	70.1	90	300
Frustration	84.6	60.2	10	240
Average WWL	48.8	11.0	29.0	60.3

Table 6. Product NASA-TLX of employee during WFO

Workload Dimension	Mean	SD	Min.	Max.
Mental Demand	179.3	94.9	0	320
Physical Demand	93.9	110.4	0	320
Temporal Demand	153.9	97.0	0	320
Performance	255	76.4	140	340
Effort	293.2	94.5	150	450
Frustration	68.2	83.8	0	260
Average WWL	69.6	6.4	57.3	78.0

5.2 Graphical Results

Data from table 5 and 6 was graphically detailed in box-whisker plot, this graphic was built to compare each NASA-TLX dimension and average WWL during WFH and WFO. Mental demand, Physical Demand, Temporal Demand, Overall Performance, Effort, Frustration, and Average WWL was showed in figure 1 until figure 7 respectively.

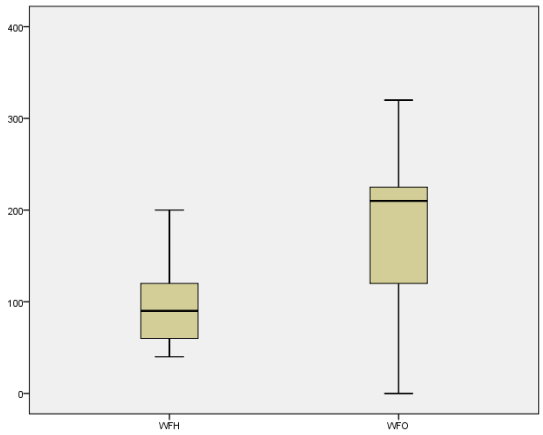

Figure 1. Mental demand during WFH and WFO

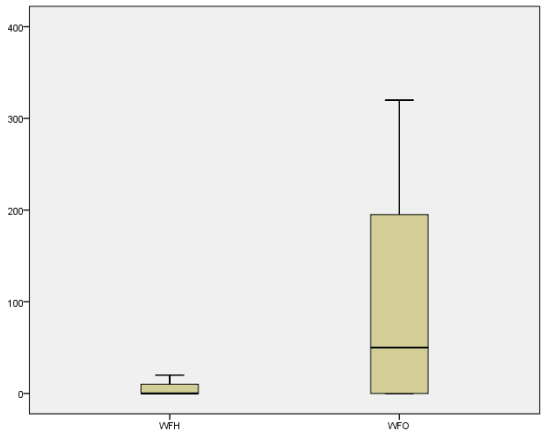

Figure 2. Physical demand during WFH and WFO

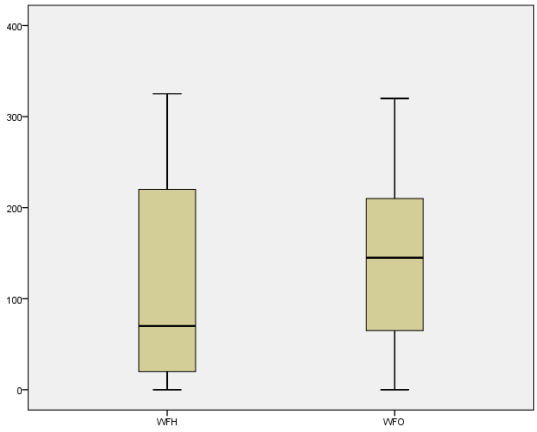

Figure 3. Temporal demand during WFH and WFO

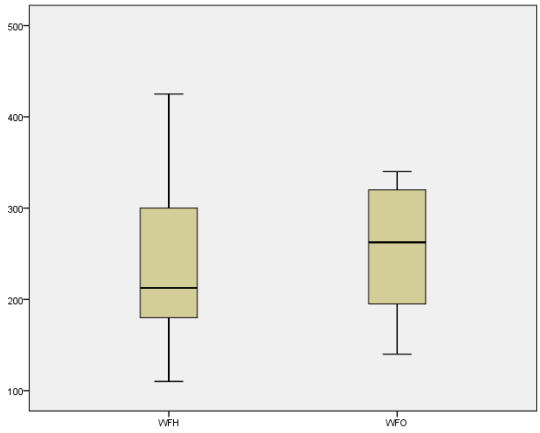

Figure 4. Overall performance during WFH and WFO

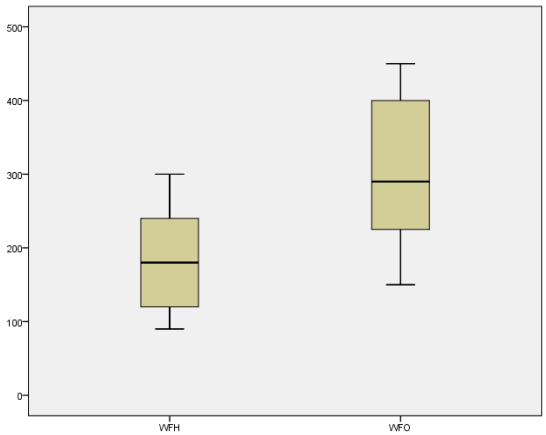

Figure 5. Effort during WFH and WFO

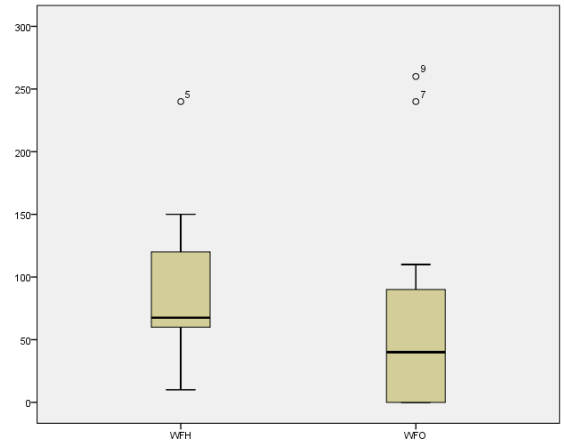

Figure 6. Frustration during WFH and WFO

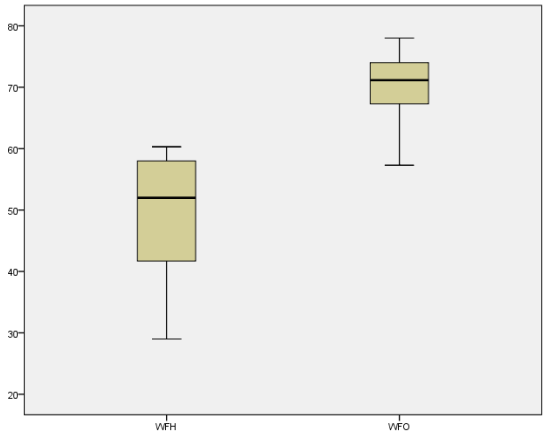

Figure 7. Average WWL during WFH and WFO

5.3 Statistical Analysis

Since the data were taken didn't meet normal distribution requirement, statistical correlation of six of workload dimension and average WWL during WFH and WFO using Wilcoxon test. Wilcoxon correlation between WFH and WFO show in table 7.

Table 7. Wilcoxon correlation between WFH dan WFO

Workload Dimension	Wilcoxon Correlation	Sig. (2-tailed)
Mental Demand	-3.186	0.001
Physical Demand	-3.190	0.001
Temporal Demand	-2.762	0.006
Performance	-2.247	0.025
Effort	-2.871	0.004
Frustration	-2.347	0.019
Average Workload (WWL)	-3.296	0.001

5.4 Discussion

This research aimed assess mental workload of employee in PT KIC during WFH and WFO due to pandemic Covid-19. Our result show average workload and six of workload dimension (mental demand, physical demand, temporal demand, overall performance, effort, Frustration) have significantly different during WFH and WFO, the data show in table 7. From figure 1 to 7 show that product workload of Mental demand, physical demand, temporal demand, effort and average WWL during WFH are lower than WFO. While, product workload of overall performance during WFH is slightly lower than WFO. Product workload of frustration during WFH higher than WFO, this is due to a lot of distraction during at home and worker must be comply the target from their job.

The highest value of Workload dimension during WFH is performance (243.6), When WFH workers tend difficult to complete their tasks, because they need data sources, discussions with co-workers, and good internet sources, these things can only be obtained during WFO. In line with the research conduct by Xiao et al. (2021) communication with co-workers decreases during WFH. While the highest value of workload dimension during WFO is Effort (293.2), workers get high mental pressure during WFO, because there are jobs that are delayed during WFH causing more effort to done their job.

While the average WWL during WFH is lower than WFO, this needs to be related to the achievement of their work targets. Is worker productivity different during WFH and WFO? Research shows that productivity during WFH is lower, but stress levels are also lower (Moretti et al. 2020). In order for the workload between WFH and WFO to be

balanced, it is necessary to have good communication between co-workers, might provide special working space for WFH and ergonomic workstation be improved the productivity.

6. Conclusion

The application of physical distancing to reduce the impact of the Pandemic of Covid-19 has made changes to the work system, as has happened to PT KIC. PT KIC applies the WFH and WFO work system. This change causes changes in the workload of workers at PT KIC. Mental workload measurement to employees in department marketing, purchasing and finance using NASA-TLX. Mental workload measurement shows that the largest workload dimension during WFH is performance, and the largest workload dimension at WFO is Effort. The results of this study also prove that there is a significant difference in the average WWL between WFH and WFO, while average workload during WFH is lower than WFO.

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