Work Mental Load Analysis on Car Repair Mechanics in Yogyakarta

Atyanti Dyah Prabaswari\textsuperscript{1,3}, Bagus Wahyu Utomo\textsuperscript{2}

\textsuperscript{1}Industrial Engineering, Universitas Islam Indonesia, Yogyakarta, Indonesia
\textsuperscript{2}Industrial Engineering, Sekolah Tinggi Teknologi Adisutjipto, Yogyakarta, Indonesia
\textsuperscript{3}atyanti.dyah@uii.ac.id

Abstract. Mechanics must work with precision, excellent and consistent speed, and other work that drains both the mechanic's physical and mental energy. Official motorbike mechanics experience complaints of work stress due to high work demands. Regarding the measurement of mental workload, a subjective workload is easily given and has a high assessment ability because the measurement is not dependent on the task. The NASA-TLX (Task Load Index) scale is the most widely used subjective scale by asking participants to rank separately on the subscale of mental demand, physical demand, temporal demand, performance, effort, and frustration level. This will be useful to be able to distinguish between tasks in terms of the specific subscale. Mental demand has the highest result (305) because the car workshop is demanded to find the cause of damage to the car, then remember the car components when dismantled and re-installed. Based on statistical analysis, between mental demand and working hours indicates a positive relationship. Heavy mental activities can be reduced by training workshop workers relating to administration, expertise in each type of car, and comfortable and safe work areas.

1. Introduction

Work fatigue is a part of general fatigue usually characterized by a reduced willingness to work due to monotony, intensity and duration of physical work, environmental conditions, mental causes, health status, and nutritional status [2]. Mechanics must work with precision, excellent and consistent speed, and other work that drains both the mechanic's physical and mental energy. Some researchers hypothesized that the indirect costs of poor working conditions, in terms of reduced performance and increased error rates, significantly impact a system's financial performance than the direct costs [3]. Official motorbike mechanics experience complaints of work stress due to high work demands [3]. Regarding the measurement of mental workload, a subjective workload is easily given and has a high assessment ability because the measurement is not dependent on the task [4]. The NASA-TLX (Task Load Index) scale is the most widely used subjective scale by asking participants to rank separately on the subscale of mental demand, physical demand, temporal demand, performance, effort, and frustration level. NASA-TLX ratings were obtained quickly (it took less than one minute to obtain the six ratings after each experimental condition). It took no more than two minutes to obtain the weights for each different type of task. This suggests that the proposed multidimensional rating scale would be a practical tool to apply in operational environments (which the nine-factor scale was not). Data analysis is substantially easier to accomplish than with SWAT, requiring a specialized conjoint analysis program. The weighted combination of factors provides a sensitive indicator of the overall.
workload between different tasks and different levels of each task. In contrast, the weights and the magnitude of the individual scales' ratings provide crucial diagnostic information about the specific loading source within the task [5]. This will be useful to distinguish between tasks in terms of the specific subscale [6].

2. Literature Review

The staff has many tasks that not only the primary task but an additional task. The additional task is from superior in the same place or the other place. The SOP for duties and distribution of tasks is not clear, so that fatigue can affect productivity. The method to measure mental workload is NASA-TLX. NASA TLX has six indicators: mental demand, physical demand, temporal demand, performance, frustration, and effort. The analysis is not only based on the result of NASA TLX but also using statistic test. The result is that the performance indicator is high that described the staff not satisfied with their job has done. The staff not satisfy but the effort has been taken out is very high. The result of Mann Whitney is not different from two groups of the period long term of working, which is divided in < 7 years and > 7 years. The correlation test result is if the staff make more effort, their tasks' satisfaction is more significant [7].

The workers will face working hours, loads, remember many patterns, and frustration when doing an outstanding task. Solar street lighting (PJU TS) installation project is affected by various risks. NASA TLX is a tool to measure the workloads. The Mental Demand (MD) has a score of 325 (the highest score) due to considerable mental activity. The Performance (P) has a score close to zero that is categorized quite well. Regression and correlation analysis between mental demand and duration of work show the direction of positive relationships. More experience makes more MD scores. That is because every PJU installation project has different criteria. The solution is bookkeeping and mind mapping regarding the type of PJU TS. Each PJU TS has the book as a guide in the field. [8].

The central control room is one department in the oil processing company; employees are tasked with monitoring the processing unit for 24 hours nonstop with a combination of 3 shifts in 8 hours. NASA-TLX is one of the subjective mental workload measurement using six factors, namely the Mental demand (MD), Physical demand (PD), Temporal demand (TD), Performance (OP), Effort (EF), frustration levels (FR). Measurement of a subjective mental workload is most widely used because it has a high degree of validity. Based on the mental workload calculation, there are 5 units (DTU, NPU, HTU, DIST, and OPS) at the control chamber (94; 83.33; 94.67; 81, 33, and 94.67 respectively) that categorize as very high mental workload. The high level of mental workload on the operator in the Central Control Room requires high accuracy, alertness, and can make decisions quickly [9].

Gojek is a service that helps people's lives by opening jobs for the community and making it easier for the community itself to live their lives. Many users of the GOJEK application also do not rule out the possibility of excessive passengers during rush hour. The needs of passengers who want to be fast and the company's needs cause gojek drivers to raise workloads on the driver itself. Therefore a study was conducted by analyzing the relationship between mental workload and work stress experienced by gojek drivers using the NASA-Task Load Index (TLX) method. Thirty gojek drivers were respondents in this study. By observing the indicators on NASA TLX, the results obtained are as many as three respondents categorized as having a very high mental workload, 26 respondents having a high category, and 1 respondent having a relatively high category. It is necessary to improve immediately to make the work become not hampered. The workload is a significant stressor that raises a type of destructive psychological reaction [10].

The literature review results show that research on work mental load is considered important to improve the work productivity of car repair mechanics. Increased productivity is useful for the car repair shop's progress and safety for the mechanic who works in the workshop, so this research is considered important to see the mental workload of the auto mechanic who is working in the car repair service.
3. Research Methodology

3.1. The Concept

NASA TLX questionnaire was distributed to car repair mechanics with a working-age between 1 year and 8 years. The NASA TLX method is used to analyze the mental workload faced by workers. Hancock and Meshkati (1988) explain that there are 6 indicators in conducting the NASA TLX method: Mental Demand (MD) is the amount of mental and perceptual activity needed to see, remember, and search. Does the work include difficult, simple or complex; Physical Demand (PD) is the amount of physical activity required by the worker (e.g. pulling, pushing, turning, and so on); Temporal Demand (TD) is time pressure felt during the work in progress. Is the work can be done slowly or quickly so that it feels tiring; Performance (P) is the success of workers in carrying out their duties and how satisfaction with the results of their work; Frustration Level (FL) is measuring how many workers feel insecure, hopeless, offended, or disturbed when doing their job; Effort (EF) is measuring a lot of hard work required by workers to achieve the required level of performance.

3.2. Data Processing

Data processing was performed to determine the value of each laboratory assistant and study program administrator's mental workload with the NASA TLX method and statistical tests. Data processing using NASA TLX calculations is as follows (Hancock and Meshkati, 1988):

3.2.1 Weighting

Respondents were asked to choose one of two more dominant indicators, causing mental workload. The selection of indicators uses a pairwise comparison.

3.2.2 Rating

Respondents were asked to give a rating of the six mental load indicators. Rating given is subjective, depending on the choice of respondents following what they feel.

3.2.3 Value

Multiply the rating by the weight factor for each indicator.

\[
\text{Product} = \text{rating} \times \text{weighting factor} \quad (1)
\]

3.2.4 Weighted Workload (WWL)

WWL is obtained by adding up the six product values.

3.2.5 WWL Average

Divide the number of WWL values by the value 15. The value is the total weight of the pairwise comparison.

3.2.6 Score Interpretation

[5] In [11] explain that the workload scores obtained are divided into Table 1.

| Workload Rank  | Value  |
|----------------|--------|
| Low            | 0-9    |
| Medium         | 10-29  |
| Quite High     | 30-49  |
| High           | 50-79  |
| Very High      | 80-100 |

3.3. The Result

The data that has been processed is analyzed how the categories of each workload mental and interpretations of values. The analysis was also assisted with statistical tests, namely the different regression and correlation tests.

A different test was carried out to see the old group working. The test is to see whether the group working for a long time affects the score. At the same time, the correlation test to find out the highest
value on the indicator of age. Conclusions are made to summarize all the results in the study, besides the advice to be given is expected to be useful for further research.

4. Result

4.1. Respondent Profile

Demographic to knowing long of work and working hours show in Tabel 2. This data to analyze using correlation testing.

| Responden | Sex | Age (year) | Long of Work (year) | Working Hours |
|-----------|-----|------------|---------------------|---------------|
| R1        | M   | 17         | 8                   | 8             |
| R2        | M   | 17         | 0.2                 | 6             |
| R3        | M   | 20         | 0.2                 | 6             |
| R4        | F   | 20         | 1.6                 | 9             |
| R5        | F   | 19         | 1                   | 9             |
| R6        | M   | 21         | 1                   | 8             |
| R7        | M   | 27         | 3                   | 8             |
| R8        | M   | 27         | 4                   | 8             |
| R9        | M   | 20         | 3                   | 8             |
| R10       | M   | 24         | 4                   | 8             |

4.2. NASA TLX

Based on the value of NASA TLX in Table 3 and the recapitulation of workload scores in Table 4, it was found that the Technicians had an average WWL of 83.47 and included in the very high category and the dominant indicator affecting the amount of mental admin workload was Mental Demand (MD) with an average of 305.

| Table 3. Value |
|----------------|
| MD  | PD  | TD  | P  | EF  | FR  |
|-----|-----|-----|----|-----|-----|
| R1  | 270 | 160 | 180| 270 | 450 | 0   |
| R2  | 100 | 300 | 450| 180 | 320 | 0   |
| R3  | 500 | 200 | 200| 100 | 300 | 200 |
| R4  | 350 | 120 | 360| 100 | 160 | 0   |
| R5  | 350 | 120 | 360| 100 | 160 | 0   |
| R6  | 500 | 200 | 300| 100 | 400 | 0   |
| R7  | 180 | 180 | 80 | 360 | 400 | 80  |
| R8  | 320 | 180 | 210| 180 | 320 | 0   |
| R9  | 320 | 180 | 240| 140 | 30  | 100 |
| R10 | 160 | 270 | 160| 70  | 320 | 180 |

| Table 4. Interpretation |
|-------------------------|
| Category | Total | Average |
| MD        | 3050 | 305     |
| PD        | 1910 | 191     |
| TD        | 2540 | 254     |
| P         | 1600 | 160     |
| EF        | 2860 | 286     |
| FR        | 560  | 56      |
| Average Total | 1252 |        |
4.3. Correlation Testing

Values of Sig. (2-tailed) between Work Hours and Mental Demand 0.808 > 0.05. Based on the r count (Pearson Correlations), the r count value for the relationship of Work Experience with Mental Demand is -0.089 < 0.549, so it can be concluded that there is no significant correlation between Working Hours and Mental Demand variables. Based on the positive Pearson correlation, the relationship between the two variables is positive. This means that if working hours get higher then Mental Demand will be higher too.

5. Discussion and Conclusion

The MD value (305) has the highest value because the work in car repair shops is demanded to find the cause of damage to the car and then to remember the car's components when it is dismantled and re-installed. The EF value (286) has the second-highest value because the workshop worker must work hard to complete the customer's car repair. The TD value (254) has the third-highest value because a workshop worker is required to repair a customer's damaged car as quickly and as well as possible.

PD value (191) has a high enough value because workers in the workshop must do work that requires a large amount of physical force, such as jacking, removing bolts, and lifting large components from the car. P-value (160) has a high enough value because workers in the workshop feel not entirely satisfied with their work results. After all, the car's completion is often late, some customers complain that the car is damaged again after being repaired, and sometimes fails to repair the damaged car. The FR value (56) has the smallest value among the other categories. This shows that workers are not disturbed by the existing working conditions.

6. Conclusion

Analysis of the correlation between mental demand and working hours shows the direction of a positive relationship. Heavy mental activities in the workshop area can be reduced by conducting training to workshop workers relating to administration, expertise in each type of car, and comfortable and safe work areas. After training or after having experienced working in a better workplace, the workers choose the improvements themselves. This is also essential for successful implementation. Since workers have selected the improvement themselves, this stage can be reduced to the realization by promotion, training, and instruction [12].

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