MOTIVECTION
Journal of Mechanical Electrical and Industrial Engineering

Volume: 7, Number: 1, 2025
ISSN: 2655 – 7215 [printed] ; 2685-2098 [online]
DOI: https://doi.org/10.46574/motivection.v7i1.436

Workload Analysis Using the NASA-TLX Method on Mechanics at PT Statika Mitrasarana Padang City

Rahmi Rahmahwati Joni[1], Milana[1]*, Donny Fernandez[1], Hendra Dani Saputra[1]

ABSTRACT

Companies that own heavy equipment require regular maintenance. The amount of workload received by mechanic in the repair and maintenance section of heavy equipment units causes them to experience physical fatigue and frustration due to the workload and working hours being conducted outside of normal working hours. This study aims to determine the workload of mechanic at PT. Statika Mitrasarana. Data collection was carried out through direct observation of the mechanic, distribution of questionnaires, and interviews regarding the workload. The analysis of workload was conducted using the National Aeronautics and Space Administration Task Load Index (NASA TLX) method. From the results of the mechanic workload, an overall average of 83.6 was obtained. The highest workload has an average of 92.66 and the lowest 65.33. On the most dominant indicator of workload the physical demands have an average of 348. The measurement findings can help management consider additional steps, such as reducing and redistributing the mechanic workload.

Keywords
Heavy Equipment, Workload, Mechanic, NASA-TLX

[1] Departemen Teknik Otomotif, Fakultas Teknik, Universitas Negeri Padang
Jln. Prof. Dr. Hamka, Air Tawar, Padang West Sumatra, Indonesia

* Corresponding Author: milana@ft.unp.ac.id

Submitted : March 24, 2025. Accepted : May 15, 2025. Published : May 20, 2025

INTRODUCTION

Every human resource has tasks and needs that correspond to their abilities [1]. When used in the context of the workplace, work performance usually refers to standards of quality and productivity [2]. Every employee must be able to complete and carry out their tasks and duties during working hours [3]. Every human activity generates a workload, whether it is light, moderate, or heavy [4]. The quantity of work that an employee is required to perform is known as their workload. In a business or organization that is the outcome of regular time and labor volume [5]. In construction projects, the use of heavy equipment is expected to speed up the work. Each piece of heavy equipment in the company requires regular maintenance or servicing to optimize the performance level of the heavy equipment to remain constant. In performing work, mechanic will face a lot of physical and mental pressure [6]. PT. Statika Mitrasarana is a construction/contractor company that handles small projects such as irrigation, drainage, roads, bridges, and projects in the districts of West Sumatra. PT. Statika Mitrasarana uses construction vehicles such as heavy equipment. Construction vehicles require proper repair, maintenance, and care before being deployed to the field. In the repair and maintenance phase, human labor it is required for this work. During tasks such as servicing, engine tune-ups, electrical work, and all those activities, they are burdened with a heavy workload.

In this condition, where the mechanic experience physical fatigue and feel frustrated due to the workload and working hours that extend beyond normal working hours, such as when the working hours can increase if the damaged heavy equipment needs to be repaired immediately because the heavy equipment is very much needed. Physical and mental fatigue will eventually affect focus while working. These conditions can also potentially reduce awareness of safety and health. The Job Creation Law Number 11 of 2020 regulates general working hours in Indonesia based on this rule, which is 7 hours a day or 40 hours a week for six working days, and 8 hours a day or 40 hours a week for five working days [7].

Measurement of workload can be conducted using various methods such as Defence Research Agency Workload Scale (DRAWS) [8] and Subjective Workload Assessment Technique (SWAT) [9], so many methods can be used to measure workload . In this study, the author used the NASA TLX method. The NASA TLX method is simple and efficient, with good validity in measuring workload subjectively. There is another relevant study titled "Workload Analysis Using the NASA TLX Method at CV. Bahagia Jaya Alsindo." It can be concluded that the highest mental workload is experienced by the hammer mill production operator during the measurement process and the material cutting workload, with an average operator workload value of 76,67, indicated by a mental demand workload and a temporal demand workload value of 75,00 [10]. The NASA TLX method measures six indicators of workload as follows Mental Demand, Physical Demand, Temporal Demand, Own Performance, Frustration Level, & Effort.

Workload

Workload is the difference between the amount of effort required to complete a task and the amount of effort that can be tolerated [11]. Morally, activity tasks are heavier because they involve brain work rather than muscle work [12]. Excessive workload can affect employees' health and cause them to become more tired and stressed, which in turn reduces their performance [13].

Mechanic

The ability to address customer issues well, kindly, and according to expectations is an important part of testing. Therefore, mechanic reliability guarantees the success rate of what has been done [14].

NASA TLX Method

According to Sandra G. Hart from NASA-Ames Research Center and Lowell E. Staveland from San Jose State University (1988), they collaborated to create NASA TLX because they wanted a sensitive and simple subjective evaluation to be used in assessing workload [15]. NASA-TLX uses a six dimensional technique to measure mental, physical, time, performance, frustration, and effort demands.

Therefore, the author will analyze the mental workload on mechanic at PT. Statika Mitrasarana, which causes physical and mental fatigue leading to a lack of focus at work.

METHOD

The type of this research is quantitative [16]. The research location is at PT. Statika Mitrasarana Jl. Khatib Sulaiman No.89, Ulak Karang Sel., Kec. Padang Utara, Kota Padang, West Sumatra 25173. The object of this research focuses on mechanic. Using the NASA TLX method, which consists of six indicators: Mental Demand, Physical Demand, Temporal Demand, Own Performance, Frustration Level, and Effort.

Analysis of mechanic workload data using the NASA TLX method with categories as follows:

Weighting

Respondents were asked to choose one of the two indicators that they believe carries a greater workload in the job. The peer option matrix of the NASA TLX dimension is shown in Table 1.

Table 1. Peer Option Matrix of the NASA TLX Dimensions [17]

	MD	PD	TD	OP	EF	FR
MD						
PD						
TD						
OP						
EF						
FR						

Ranking

Respondents are asked to evaluate the six indicators of workload. The rating scale is shown in Table 2.

Table 2. Rating Scale [18]

	Indicator	Scale
1.	***Mental Demand*** **(MD)** How great are the difficulties faced by a mechanic when performing repairs, replacements, maintenance, and upkeep on heavy equipment?	0-100
2.	***Physical Demand*** **(PD)** How much physical effort is required by a mechanic to perform repairs, replacements, maintenance, and servicing on heavy equipment?	0-100
3.	***Temporal Demand*** **(TD*)*** How long do mechanic have to work to repair, replace, maintenance, and heavy equipment? Is the work done quickly and exhaustingly, or slowly and allowing time for breaks?	0-100
4.	***Own Performance*** **(OP)** How effective are mechanic in repairing, replacing, maintaining, and servicing heavy equipment?	0-100
5.	***Frustration Level*** **(FR)** How many mechanic feel confused, unsafe, or uncomfortable when performing repairs, replacements, maintenance, and servicing on heavy equipment?	0-100
6.	***Effort*** **(EF)** How much effort is required by a mechanic to perform repairs, replacements, maintenance, and upkeep on heavy machinery?	0-100

Calculating the product value

In calculating this product, where the rating and weight are multiplied to obtain results from 6 indicators (MD, PD, TD, OP, FR, EF) [19].

$$\text{Product value} = \text{Rating} \times \text{Factor weight} \quad (1)$$

Calculating weighted workload (WWL)

Obtained from the product of the weight multiplied by the rating, then summed up.

$$\text{WWL} = \sum \text{Product value} \quad (2)$$

Calculating the average WWL

By dividing WWL by a total weight equal to 15. Here is the formula used to perform the calculation.

$$\text{Average WWL} = \frac{\sum \text{Product value}}{15} \quad (3)$$

Score interpretation

After obtaining the results from the weighted workload (WWL) value, the score can be determined based on the workload category [11]. The workload score is shown in Table 3.

Table 3. Workload Score

Workload category	Value
Low	0-50
Medium	51-79
High	80-100

RESULT AND DISCUSSION

Results

The data that has been obtained will be processed using the NASA TLX calculation. A summary of the NASA TLX calculation results shown in Table 4. The NASA TLX calculation for one of the mechanic is shown in Table 5 and the recap of the WWL (Weighted Workload) values for the mechanic shown in Table 6.

Table 4. Summary of NASA TLX Calculation Results

No	Name	Age	Indicator	Weight	Rating	WWL
1.	Rahmad Sutejo	48 years	MD	2	80	1390
			PD	4	100	
			TD	4	90	
			OP	1	90	
			FR	1	80	
			EF	3	100	
2.	Yovi Jenery	40 years	MD	1	60	980
			PD	4	70	
			TD	2	50	
			OP	1	70	
			FR	5	70	
			EF	2	60	
3.	Febrinaldi	48 years	MD	3	80	1360
			PD	1	80	
			TD	0	60	
			OP	5	100	
			FR	2	70	

No	Name	Age	Indicator	Weight	Rating	WWL
			EF	4	100	
4.	Jefisa	38 years	MD	1	50	1260
			PD	5	90	
			TD	4	80	
			OP	3	80	
			FR	0	50	
			EF	2	100	
5.	Tomi Imran	36 years	MD	2	70	1210
			PD	5	90	
			TD	3	80	
			OP	2	70	
			FR	1	60	
			EF	2	90	
6.	Satria Wahyudi	48 years	MD	4	70	1170
			PD	3	80	
			TD	2	70	
			OP	1	70	
			FR	3	80	
			EF	2	100	
7.	Tugiyono	69 years	MD	2	60	1210
			PD	4	90	
			TD	3	70	
			OP	2	60	
			FR	0	60	
			EF	4	100	
8.	Jumardi	42 years	MD	2	80	1390
			PD	4	90	
			TD	3	100	
			OP	3	90	
			FR	0	80	
			EF	3	100	
9.	Andra Putra	40 years	MD	2	60	1260
			PD	4	90	
			TD	4	90	
			OP	3	80	
			FR	0	70	
			EF	2	90	
10.	Ahmad Junaidi	48 years	MD	1	60	1310
			PD	5	100	
			TD	3	90	
			OP	2	80	
			FR	1	50	
			EF	3	90	

Table 5. NASA TLX calculation for one of the mechanic

Rahmad Sutejo			
Indicator	**Weight**	**Rating**	**Weight x Rating**
Mental Demand	2	80	160
Physical Demand	4	100	400
Temporal Demand	4	90	360
Own Performance	1	90	90
Frustration Level	1	80	80
Effort	3	100	300
		WWL	1390
		Average WWL	92,66

Table 6. Recapitulation of WWL (Weighted Workload) Values for Mechanic

No	**Name**	**Average WWL**	**Workload Category**
1.	Rahmad Sutejo	92,66	High
2.	Yovi Jenery	65,33	Medium
3.	Febrinaldi	90,66	High
4.	Jefisa	84	High
5.	Tomi Imran	80,66	High
6.	Satria Wahyudi	78	Medium
7.	Tugiyono	80,66	High
8.	Jumardi	92,66	High
9.	Andra Putra	84	High
10.	Ahmad Junaidi	87,33	High
	Average	83,6	

Discussion

The results of data processing using the NASA-TLX method were obtained by calculating the individual product/respondent values, WWL, and the final NASA-TLX score. The ranking value for the product/respondent is multiplied by the weighting value corresponding to the content of the questionnaire filled out by the mechanic. The results of measuring workload using the NASA TLX method show that mechanic have an overall average workload of 83,6. The highest workload has an average of 92,66 and the lowest of 65,33. From six NASA TLX indicators (MD, PD, TD, OP, FR, EF), those with the highest scores consist of 6 people because they have WWL scores above average, while those below average consist of 4 people. This shows that mechanic have different workload for each individual while work. The diagram shows the results of the workload of mechanic as shown in Figure 1.

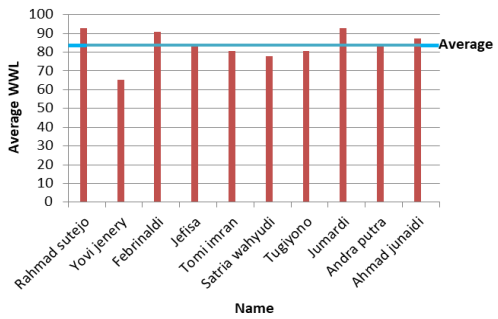

Figure 1. Diagram of the Average Workload of Mechanic

Comparison of NASA TLX Score Elements

Comparison of NASA TLX score elements shows which indicator is the most dominant. Based on the results of summing each indicator and dividing by the number of respondents, it can be noted that the most influential factor on the workload of mechanic at PT. Statika Mitrasarana is the physical demand indicator, which is 348. The work of a mechanic requires strong and significant stamina when performing tasks as a mechanic. Repairing, disassembling, assembling, and maintaining heavy equipment requires strength because heavy equipment is specifically designed for earthmoving operations and construction tasks. The components and engines of heavy machinery are larger compared to light vehicles, which makes mechanic feel fatigued. The solution for the company in addressing this issue is to provide additional mechanic to work when heavy equipment is urgently needed. Therefore, physical demand has the highest average compared to the other indicators. After physical demand, it is followed by the effort and temporal demand indicators, which are 255 and 230, respectively. Then the performance and mental demand indicators were 190 and 139. Then the frustration level indicator is 92. The comparison diagram of the NASA TLX score elements is shown in Figure 2.

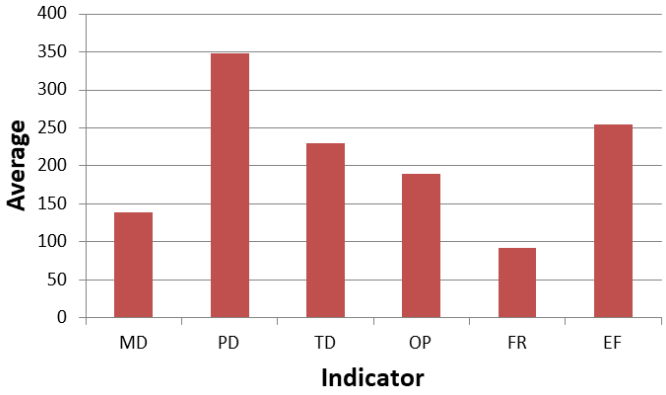

Figure 2. Comparison Diagram of NASA TLX Score Elements

Recommendation for Improvement

Aspect of Physical Demand

Aspect of Physical Demand in a mechanic environment, physical strength is highly prioritized because the energy expended must be significant and strong in performing tasks, as well as maintaining a clean working environment. The average produced in the Physical Demand is 348. The proposed improvement is to provide additional mechanic in the work process if heavy machinery is highly needed. Creating a supportive work environment, such as improving the physical conditions of the workplace to make it more comfortable and healthy for working.

Aspect of Effort

Effort in heavy equipment repair work, despite limitations in ability and lack of expertise, serves as a driving force to complete tasks. The average Effort produced is 255. The improvement suggestion is to create a structured task design, such as providing clear task instructions, relevant skills training so that mechanics feel more prepared and confident in their work, and offering mentoring or coaching to help mechanics face challenges in their work.

Temporal Demand Aspect

Temporal Demand Aspect or time requirement, the mechanic job has a work hour set by the company, which is around 8 hours. Working hours outside of normal working hours or overtime also occur during work. The average produced in Temporal Demand is 230. The proposed improvement is to adjust overtime for mechanic to prevent unwanted serious work

accidents. Provide space and limit overtime work if it exceeds, and give adequate rest time according to the work performed.

Performance Aspect

A good performance aspect can be said to be the mechanic performance in carrying out their work. The average produced in Own Performance is 190. The improvement suggestion for performance is to provide mentoring or coaching to help the mechanic face challenges in their work and to appreciate every performance result achieved by the mechanic in servicing heavy equipment, such as by giving awards.

Aspect of Mental Demand

The average produced for Mental Demand is 139. A small number of mechanic feel that their skills in tasks such as disassembly, assembly, and repair of heavy equipment are lacking or that they do not have the ability to work on heavy equipment. The proposed improvement is to hold training activities for mechanic who have not yet mastered those skills in order to enhance their abilities as heavy equipment mechanic.

Aspect of Frustration Level

In the aspect of Frustration Level, the average produced is 92. The improvement suggestion is to provide training or course activities for mechanic to enhance their skills and increase their knowledge about heavy equipment. Providing stress management programs such as counseling or stress management workshops.

The aspect that indicates a high workload is found in the Physical Demand aspect. The Physical Demand aspect has an average of 348, which can be interpreted as a main focus for mechanic in their work because it requires strong physical ability when working with something heavy, such as heavy equipment mechanic. Physical Demand affects Mental Demand, Temporal Demand, Performance, Frustration Level, and Effort.

CONCLUSION AND RECOMMENDATION

Conclusion

The results of measuring workload using the NASA TLX method show that mechanic have an overall average workload of 83,6. The highest workload has an average of 92,66 and the lowest of 65,33. From six NASA TLX indicators (MD, PD, TD, OP, FR, EF), those with the highest scores consist of 6 people because they have WWL scores above average, while those below average consist of 4 people. This shows that mechanic have different workload for each individual while work.

Based on the results of summing each indicator and dividing by the number of respondents, it can be determined that the most influential factor on the workload of mechanic at PT. Statika Mitrasarana is the physical demand, which is 348. Repairing, dismantling, assembling, and maintaining heavy equipment requires physical strength because heavy equipment is specifically designed for earthworks and construction tasks. The components and machines of heavy equipment are larger compared to light vehicles, which makes mechanic feel fatigued. Therefore, physical demand has the highest average compared to other indicators. After physical demand, it is followed by the effort and temporal demand indicators at 255 and 230, respectively. The performance and mental demand indicators are at 190 and 139.Then the frustration level indicator was 92.

Suggestion

The results of this measurement can help management consider further actions, such as reducing and reallocating workload for tasks with above average scores from mechanic.

Based on the proposed improvements, the Mental Demand aspect for mechanic includes conducting training sessions for mechanic who have not yet mastered the skills to enhance their abilities as heavy equipment mechanic. In the aspect of Physical Demand, if the work is too

complicated and cannot be done alone, then provide additional mechanic first if heavy equipment is urgently needed and create a comfortable and healthy physical work environment. In the aspect of temporal demand, provide space and limit overtime work if it exceeds, and give sufficient rest time according to the work being done. Then, the aspect of mechanic performance should include mentoring or coaching to help mechanic face challenges in their work and Providing stress management programs such as counseling or stress management workshops while also appreciating every performance result achieved by the mechanic in their work as heavy equipment providers, such as giving awards. Creating a structured task design, such as providing clear task instructions and relevant skills training, so that mechanic feel more prepared and confident in their work. It is expected that future research will examine the company's work processes in more detail to identify issues that require immediate attention.

REFERENCE

[1] M. A. Maulana and D. D. Nurkertamanda, "Analysis Of Mental Workload Using The Nasa-Tlx Method On Workers In The Workshop Department (Case Study: Pmks Sei Basau Pt Surya Agrolika Reksa)".

[2] M. Masniar, A. R. Histiarini, and D. A. B. Pangestu, "Analysis Of Mental Workload Using The Nasa-Tlx Method In The Operator Section," Metode J. Tek. Ind., vol. 8, no. 1, pp. 11–20, Mar. 2022, doi: 10.33506/mt.v8i1.1695.

[3] M. Fikri, "Analysis Of Physical And Mental Workload Using Cvl And Nasa-Tlx Methods In The Quality Control Department Of A Food Company In Bekasi".

[4] Santika Sari, "Workload Analysis Using the NASA-TLX Method on Employees of Telkom Applied Science School Bandung," J. Teknol. DAN Manaj. Ind., vol. 5, no. 2, pp. 1–6, Aug. 2019, doi: 10.36040/jtmi.v5i2.272.

[5] M. Tinambunan, K. Kusnadi, and A. H. Maksum, "Analysis of Physical and Mental Workload Using the Job Strain Index and NASA-TLX Methods on CV. SBRC," *Motiv. J. Mech. Electr. Ind. Eng.*, vol. 4, no. 3, pp. 341–354, Sep. 2022, doi: 10.46574/motivection.v4i3.157.

[6] U. N. Harahap, N. Andrian, and D. W. Utama, "Analysis of Physical and Mental Workload Using CVL and DRAWS Methods," J. Apl. Ilmu Tek. Ind. JAPTI, vol. 5, no. 1, pp. 32–39, Mar. 2024, doi: 10.32585/japti.v5i1.5160.

[7] antaranews.com, "Official working hours regulations according to Kemenaker provisions,"Antara News.Accedido: 07 de mayo de 2025.[Online].Available: https://www.antaranews.com/berita/4391194/peraturan-jam-kerja-resmi-menurut-ketentuan-kemenaker

[8] C. I. Erliana and S. Mawaddah, "Analysis of Supervisor and Fireman Workload Measurement at PT Perta Arun Gas Using the Defence Research Agency Workload Scale,"Ind. Eng. J., vol. 8, no. 2, Oct. 2019, doi: 10.53912/iejm.v8i2.411.

[9] A. D. Sukhrisno, E. Azriadi, A. Fiatno, R. K. Sari, and L. S. Tanjung, "Workload Analysis Using the SWAT Method Case Study at PT Dipayana Okta Abadi," J. Tek. Ind. Terintegrasi, vol. 5, no. 2, pp. 120–135, Dec. 2022, doi: 10.31004/jutin.v5i2.9279.

[10] A. Pramesti and E. Suhendar, "Workload Analysis Using the NASA-TLX Method at CV. Bahagia Jaya Alsindo," STRING Satuan Tulisan Ris. Dan Inov. Teknol., vol. 5, no. 3, p. 229, Apr. 2021, doi: 10.30998/string.v5i3.6528.

[11] E. Krisnaningsih, S. Dwiyatno, T. Arlani, A. D. Jubaedi, and D. Cahyadi, "Psychological And Physical Workload With Nasa-Tlx And Cardiovascular Load (CVL),"J. Intent J. Ind. and Technol. Terpadu, vol. 6, no. 1, pp. 1–13, Jun. 2023, doi: 10.47080/intent.v6i1.2588.

[12] D. Pratiwi, "Measurement of Mental Workload Using the NASA-TLX Method at CV Maju Sejahtera Lestari Medan," Thesis, Universitas Medan Area, 2022.Accessed: May 08, 2025.[En línea].Disponible: https://repositori.uma.ac.id/handle/123456789/17073
[13] Tiari Rahma Fani and Yudi Ferdiana Permana, "The Influence of Workload and Work Stress on Employee Performance at the Cigugur Tengah Village Office," JEMSI J. Ekon. Manaj. Dan Akunt., vol. 10, no. 4, pp. 2179–2185, Aug. 2024, doi: 10.35870/jemsi.v10i4.2557.
[14] Ibnu Sholihin, Hendra Harmain, and Muhammad Syahbudi, "Analysis of the Influence of Mechanic Service, Location, Company, and Product Warranty on Customer Satisfaction at Astra Honda Authorized Service Station in Galang District,"Pop. J. Student Research, vol. 2, no. 1, pp. 87–105, Feb. 2023, doi: 10.58192/populer.v2i1.541.
[15] S. G. Hart and L. E. Staveland, "Development of NASA-TLX (Task Load Index): Results of Empirical and Theoretical Research," in *Advances in Psychology*, vol. 52, Elsevier, 1988, pp. 139–183. doi: 10.1016/S0166-4115(08)62386-9.
[16] "Quantitative, Qualitative, and R&D Research Methods_ Sugiyono 2020."Accessed: May 07, 2025.[En línea].Disponible: https://online.anyflip.com/xobw/rfpq/mobile/
[17] K. Virtanen, H. Mansikka, H. Kontio, and D. Harris, "Weight watchers: NASA-TLX weights revisited," *Theor. Issues Ergon. Sci.*, vol. 23, no. 6, pp. 725–748, Nov. 2022, doi: 10.1080/1463922X.2021.2000667.
[18] Y. Ardila, "Evaluation of Student Mental Workload Using the Academic Information System of Universitas Jambi with the NASA-TLX Method," other, Universitas Jambi, 2023.Accessed: May 08, 2025.[En línea].Available: https://repository.unja.ac.id/
[19] F. A. Haq, W. Wahyudin, and F. Pratiwi, "Analysis of Mental Workload in The Production Department PT. XYZ Using NASA-TLX Method," *Motiv. J. Mech. Electr. Ind. Eng.*, vol. 5, no. 1, pp. 161–172, Jan. 2023, doi: 10.46574/motivection.v5i1.199.