

Mental Workload Analysis of Employees Using the National Aeronautics and Space Administration Task Load Index (NASA-TLX) Method (Case Study of CV. XYZ Candi)

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Abstract

CV. XYZ Candi operates in the manufacturing and services sector, particularly the production of industrial machine spare parts. High productivity demands are often directly proportional to increased employee mental workload—problems at CV. XYZ Candi Technical problems, such as frequent chisel breaks, material delays, engineering drawing errors, and material mismatches (materials not centered), also exacerbate the situation. This is further compounded by employee capabilities that are not fully aligned with the task's complexity, as well as a less-integrated workflow system. To analyze this problem comprehensively, the NASA-TLX (Task Load Index) method was chosen as an evaluation tool. NASA-TLX measures mental workload multidimensionally through six indicators: mental demand, physical demand, time requirements, performance, effort level, and frustration level. This method is relevant to apply to a CV. XYZ Candi can identify dominant factors that contribute to workload, such as time pressure, task difficulty, and priority conflicts. Most respondents (57.2%) experienced moderate mental workload, 33.3% high, and 9.5% low mental workload among the 21 employees at CV. XYZ Candi experienced very high mental workloads, with the highest scores influenced by physical demands, time demands, effort levels, and frustration levels.

Keywords: Mental Workload, NASA-TLX, Employee.

Abstrak

CV. XYZ Candi bergerak dibidang manufaktur dan jasa khususnya produksi spare part mesin industri. Tuntutan produktivitas yang tinggi seringkali berbanding lurus dengan peningkatan beban kerja mental karyawan. Permasalahan yang ada pada CV. XYZ Candi seperti pahat sering putus, keterlambatan material, kesalahan gambar teknik, dan ketidaksesuaian bahan (bahan tidak senter) turut memperparah situasi. Hal ini diperkuat oleh kemampuan karyawan yang belum sepenuhnya sesuai dengan kompleksitas tugas, serta

sistem alur kerja yang kurang terintegrasi. Untuk menganalisis masalah ini secara komprehensif, metode NASA-TLX (Task Load Index) dipilih sebagai alat evaluasi. NASA-TLX mampu mengukur beban kerja mental secara multidimensi melalui enam indikator: kebutuhan mental, kebutuhan fisik, kebutuhan waktu, performansi, tingkat usaha, dan tingkat frustrasi. Metode ini relevan diterapkan di CV. XYZ Candi karena mampu mengidentifikasi faktor dominan yang berkontribusi terhadap beban kerja, seperti tekanan waktu, kesulitan tugas, dan konflik prioritas. Sebagian besar responden (57,2%) mengalami beban kerja mental sedang, 33,3% tinggi, dan 9,5% rendah. Dari 21 karyawan CV. XYZ Candi, tujuh orang mengalami beban kerja mental sangat tinggi, dengan nilai tertinggi dipengaruhi oleh kebutuhan fisik, kebutuhan waktu, tingkat usaha, dan tingkat frustrasi.

Keywords: Beban Kerja Mental, NASA-TLX, Karyawan.

1. Introduction

In today's work world, employees often face challenges that affect productivity and health. This phenomenon is not limited to the manufacturing sector but also extends to the service, technology, and other formal industries. Common phenomena among employees include work overload, physical and mental health issues, and mismatches between workflows and available resources. Power, environmental impact, non-ergonomic Work, Imbalance in work-life balance, high turnover, decreased loyalty, and human error due to cognitive load.

This research was conducted by CV. XYZ Candi, which operates in the manufacturing and services sector, specifically the production of industrial machine spare parts. High productivity demands are often directly proportional to increased employee workload. Work-related mental stress can lower performance, trigger operational errors, and impact the physical and psychological health of workers. CV. XYZ Candi, a company engaged in the production of industrial machine spare parts, faced complex problems related to employee mental workload. Based on initial observations, several contributing factors included: a daily production target of 100 units, tight deadline pressure, machine trouble, and hard materials that require intensive processing. Besides that, employees often experience fatigue (eye strain) from prolonged welding, as well as stress due to suboptimal workflows, such as the accumulation of tasks when the previous job has not been completed, but a new task has been assigned. For this reason, this study will discuss mental workload at work.

According to [1], workload is the amount of work required of someone to fulfill the demands or requirements of a job. Individual capacity, which is a measure of a person's ability, is closely related to their physical and mental condition. Burden Work can be interpreted as part of Man Limited's capacity and used to complete a task. Mental workload is defined as the difference between the level of cognitive demands required to complete a job and the individual's optimal mental capacity in a motivated state [2].

Mental workload can impact employee performance and productivity if they experience stress or mental fatigue due to demanding Work or Work that doesn't match their abilities. Measuring mental workload through a subjective approach is the most commonly used method because it offers high validity and immediate results.

Several factors can influence Mental Workload, including external factors, such as task physique and psychological, organizational, and environmental factors, and internal factors, such as type, sex, age, body size, nutritional status, and health condition, as well as psychological factors such as motivation, perception, belief, desire, and satisfaction.

Because Mental Workload can impact workers' health, safety, productivity, and performance, it is essential to understand and measure it to reduce risks to workers' health and safety while increasing productivity and performance.

Problems with CV. XYZ Candi faces technical issues, including frequent chisel breaks, material delays, errors in technical drawings, and material mismatches (materials not being centered), which exacerbate the situation. This is further compounded by employees' skills that are not fully aligned with the task's complexity, as well as by system channels that are not fully integrated. The impact: Employees report symptoms of chronic fatigue, increased stress levels, and decreased work motivation. This phenomenon indicates an imbalance between work demands and work-life balance. Task (task demand) and capacity sources of human resources can disrupt the sustainability of company operations.

To analyze this problem comprehensively, the NASA-TLX (Task Load Index) method was chosen as an evaluation tool. NASA-TLX can measure task load. Work mentally in a multidimensional way through six indicators: need mental, need physical, require time, performance, level of business, and level of frustration. According to [3], NASA-TLX was developed by NASA Ames Research Center. NASA-Task Load Index is a multidimensional rating procedure which divides the workload based on the average loading of 6 subscales, namely:

- a. Mental demands, or mental needs, are the activity and perceptual demands required in a job. Examples include thinking, remembering, searching, and seeing.
- b. Physical demands or need a physique, as in tasks requiring physical activity, such as lifting heavy objects while working.
- c. Temporal demands or need time: as far as tasks are concerned, these tasks require time to complete. For example, meeting daily or weekly production targets.
- d. Performance is an indicator that assesses the level of success and satisfaction of workers in carrying out a task. For example, like guard accuracy results, the lathe (for example, tolerance size).
- e. Level of business (effort) is the amount of effort put into a given approach. A person's physical and mental effort in completing their work to achieve the desired results. For example, high focus when measuring and adjusting machines.
- f. Frustration is a psychological state that reflects employees' emotional responses when performing their jobs—some form of frustration, among other stressors, such as discomfort, feelings of despair.

This questionnaire was developed to address the need for a subjective workload measurement tool that is easier to use yet remains accurate and sensitive. This relevant method is implemented in the CV. XYZ Temple can identify the dominant factors contributing to workload, such as time pressure (chasing deadlines), task difficulty (difficult work), and conflicting priorities (piling up tasks). The results of this analysis are expected to form the basis for recommendations to improve workflows, adjust production targets, and train employees to increase efficiency and mental Well-being.

NASA-TLX is used not only for evaluation but also to assess mental workload among experienced workers and to provide a basis for improvement recommendations. By understanding which indicators contribute most to mental stress, management can take steps to alleviate the burden. For example, setting up a repeatable process and work, and adding training, can help reduce the pressure employees feel [4].

2. Method

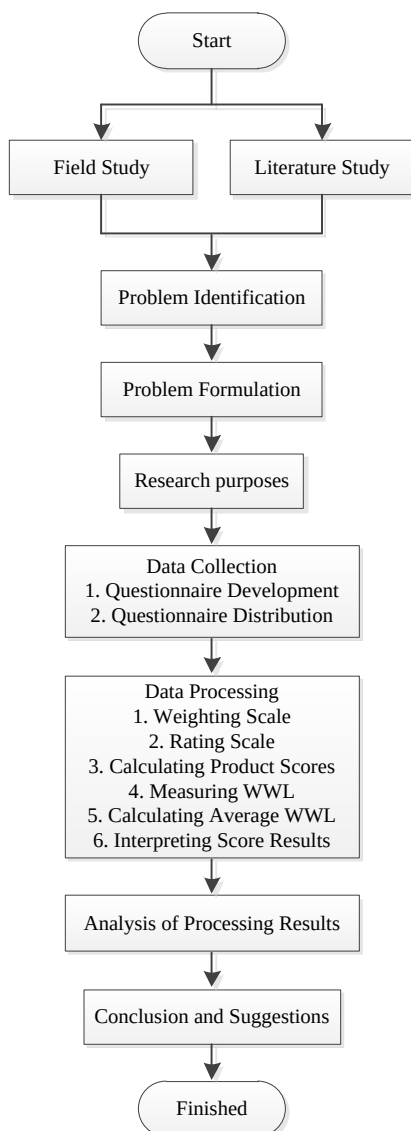


Figure 1. Research Flowchart

This study used two types of data: primary and secondary data. Primary data was collected through interviews and the completion of the NASA-TLX questionnaire by CV. XYZ Candi employees. Meanwhile, secondary data was obtained from internal company documents relevant to the research topic. The research steps are shown in Figure 1.

The NASA-TLX method explains the steps in the mental workload measurement process below.

- a. **Weighting.** In the weighting stage, respondents are asked to compare each pair of indicators using different comparison methods. The total number of comparisons among the six indicators is 15, and the results are used to determine the weight of each indicator [5].
- b. **Giving Rating.** According to [6], respondents were asked to rate six indicators of mental workload. This assessment was subjective and adjusted to the level of psychological stress they experienced. Each indicator was assigned a scale of 0 to 100, and respondents rated it accordingly. With a level burden, work felt during work.
- c. **Calculating Product Value.** According to [7], the values for the six assessment indicators (Mental Needs, Need Physique, Need Time, Performance, Level Business, Frustration Level) are obtained by multiplying each indicator's weight by its rating.

$$\text{Product} = \text{Weight} \times \text{Rating} \quad (1)$$

Product: The product value in NASA-TLX is the overall workload score, derived from ratings and weights for each indicator. This score reflects how much mental, physical, or emotional effort the user feels when using the product.

Rating: NASA-TLX has six indicators that users rate on a scale of 0–100. These ratings measure users' perceptions of each aspect of the workload

Weight: Weight determines the relative importance of each indicator to the user. Weight is determined by comparing pairs of 6 indicators, where users choose which are more relevant to their experience.

- d. **Count Weighted Workload (WWL)**

Mark WWL can be obtained by adding up six marks for each indicator.

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

- e. **Count flat - flat WWL**

The steps to calculate the average WWL are to divide the total value by the accumulation weight of 15. The following is the formula used:

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

- f. **Interpretation results mark score**

Explanation of Hard and Staveland 1981 in [7]. According to the NASA-TLX theory, mental workload is classified into three levels: low, medium, and high. Details of the score categorization are presented in Table 1.

Table 1. Determination Category Results Mark Score Method NASA- TLX

Category Burden Work Mental	Assessment Score
Burden Work low	0 until with 50
Burden Work currently	51 until 80
Burden work tall	81 up to 100

3. Results and Discussion

In this questionnaire, respondents, namely 21 employees of CV. XYZ Candi then completed a comparison questionnaire on several indicators. The mental workload consists of 15 questions and gives ratings on the NASA-TLX method. There are six indicators: Need Mental (NM), Physical Needs (PN), Need Time (NT), Performance (P), Level of Business (LB), and Frustration Level (FL). For example, the questionnaire comparison in pairs is shown in the results for the employee.

Table 2. Weighting Summary

No	Worker Name	Indicator						Total
		NM	PN	NT	P	LB	FL	
1.	Ibad	2	0	3	4	5	1	15
2.	Rizki Kurniawan	3	1	3	3	4	1	15
3.	Alex	0	4	4	1	2	4	15
4.	Reza	1	2	5	4	3	0	15
5.	Taufik	2	1	3	5	4	0	15
6.	Sumarjono	3	3	2	5	2	0	15
7.	Arya	3	3	5	3	1	0	15
8.	Ariel	2	4	3	4	2	0	15
9.	Gufron	1	2	3	4	5	0	15
10.	Joko	2	5	2	3	0	3	15
11.	Saiful Afandi	1	0	2	4	5	3	15
12.	Friday	4	3	3	2	3	0	15
13.	Djafar	1	4	4	3	1	2	15
14.	Salim	2	3	5	4	0	1	15
15.	Suparno	1	4	5	3	2	0	15
16.	Rindito	2	4	3	1	5	0	15
17.	Aldi	2	3	1	4	3	2	15
18.	Bastian	4	2	3	1	0	5	15
19.	Dian	2	1	4	3	5	0	15
20.	Samsul	2	3	4	4	2	0	15
21.	Bambang	3	1	2	5	4	0	15

Based on the weighting questionnaire results, several indicators showed a value of 0 for some respondents. This indicates that workers perceived the workload on these indicators to be very low or insignificant during their work. Carry out his job. For example, in several positions for lathe operators, the level of frustration is perceived as very low, leading respondents to give this indicator a score of 0. The next step is rating.

Respondents rate six mental workload indicators, including Mental Needs, Physical Needs, Time Needs, Performance, Level Business, and Level Frustration. Every evaluation is subjective and adjusted to each employee's perception of their mental workload, which is measured on a scale of 0 to 100.

Table 2. Recap Rating

No	Worker Name	NM	PN	NT	P	LB	FL
1.	Ibad	50	50	60	90	50	40
2.	Rizki Kurniawan	70	80	60	80	70	50
3.	Alex	85	80	99	70	90	80
4.	Reza	70	80	80	90	70	40
5.	Taufik	80	60	50	80	100	40
6.	Sumarjono	80	60	50	90	80	40
7.	Arya	90	70	80	90	90	70
8.	Ariel	50	30	40	40	30	0
9.	Gufron	50	50	60	100	50	50
10.	Joko	90	70	90	100	90	100
11.	Saiful Afandi	80	70	100	99	80	90
12.	Friday	50	50	50	100	90	50
13.	Djafar	50	70	100	90	100	50
14.	Salim	50	50	50	50	50	50
15.	Suparno	70	80	80	90	80	50
16.	Rindito	80	80	80	90	90	30
17.	Aldi	80	80	90	70	80	70
18.	Bastian	100	100	100	100	100	100
19.	Dian	60	80	80	90	70	70
20.	Samsul	70	80	90	70	80	80
21.	Bambang	80	60	70	90	70	50

Table 2 shows that the Frustration Level (TF) indicator for employee Aril is 0, meaning he does not experience stress, anxiety, or pressure while performing his work. The next step is data processing using NASA-TLX. For example, for employee Ibad, the data processing is as follows:

Count mark products from the indicator burden Work

$$\text{a. Mental Needs} = \text{Weight} \times \text{Rating} = 2 \times 50 = 100$$

b. Physical Needs	=	Weight x Rating	=	0 x 50	=	0
c. Time Requirement	=	Weight x Rating	=	3 x 60	=	180
d. Performance	=	Weight x Rating	=	4 x 90	=	360
e. Level Effort	=	Weight x Rating	=	5 x 50	=	250
f. Frustration Level	=	Weight x Rating	=	1 x 40	=	40

Count Weighted Workload (WWL)

$$\text{WWL} = \sum \text{Product Value} = 100 + 0 + 180 + 360 + 250 + 40 = 930$$

Count average Weighted Workload (WWL)

$$\text{Average WWL} = \frac{\sum \text{WWL}}{15} = \frac{930}{15} = 62$$

A recapitulation of the WWL results and the average WWL is shown in Table 3.

Table 3. Summary of Average WWL Calculations

No	Worker's name	WWL	Average WWL
1.	Ibad	930	62
2.	Rizki Kurniawan	1,040	69.33
3.	Alex	1,286	85.73
4.	Reza	1,200	80
5.	Taufik	1,170	78
6.	Sumarjono	1,130	75.33
7.	Arya	1,240	82.66
8.	Ariel	560	37.33
9.	Gufron	980	65.33
10.	Joko	1,310	87.33
11.	Saiful Afandi	1,346	89.73
12.	Friday	970	64.66
13.	Djafar	1,200	80
14.	Salim	750	50
15.	Suparno	1,220	81.33
16.	Rindito	1,260	84
17.	Aldi	1,150	76.66
18.	Bastian	1,500	100
19.	Dian	1,140	76
20.	Samsul	1,180	78.66
21.	Bambang	1,170	78

The next stage in this research is classification. Burden Work mental based on the analysis of NASA-TLX. Classification level workload mental employee CV. XYZ Temple, as calculated using the NASA-TL method, is shown in Table 4.

Table 4. Classification of Workload Levels

No	Worker's name	Average WWL	Workload classification
1.	Ibad	62	Currently
2.	Rizki Kurniawan	69.33	Currently
3.	Alex	85.73	Tall
4.	Reza	80	Currently
5.	Taufik	78	Currently
6.	Sumarjono	75.33	Currently
7.	Arya	82.66	Tall
8.	Ariel	37.33	Low
9.	Gufron	65.33	Currently
10.	Joko	87.33	Tall
11.	Saiful Afandi	89.73	Tall
12.	Friday	64.66	Currently
13.	Djafar	80	Currently
14.	Salim	50	Low
15.	Suparno	81.33	Tall
16.	Rindito	84	Tall
17.	Aldi	76.66	Currently
18.	Bastian	100	Tall
19.	Dian	76	Currently
20.	Samsul	78.66	Currently
21.	Bambang	78	Currently

Based on the classification of the results of mental workload calculations using the method NASA-TLX for 21 employees' CVs. XYZ Temple, obtained results that the majority of respondents, namely 12 people are Ibad, Rizki Kurniawan, Reza, Taufik, Sumarjono, Gufron, Friday, Djafar, Aldi, Dian, Samsul, and Bambang, is at on load category Work mental currently with score WWL average between 51–80. Next, there are seven people, namely Alex, Arya, Joko, Saiful Afandi, Suparno, Rindito, Bastian, who are included in the category burden work mental tall with mark average WWL in on 81, And only two person that is Ariel and Salim, which is at in the low mental workload category with a WWL score below 50. This shows that the majority of employees experience relatively high work pressure.

4. Conclusion

Based on the results analysis, the burden of the NASA-TLX mental workload method for 21 employees in the CV. At XYZ Temple, most employees experienced a level of cognitive workload in the medium category (57.2%), followed by the high category (33.3%), and only a small portion were in the low category (9.5%). The employees who experienced the most mental workload were in the medium category (57.2%), followed by the high category (33.3%),

and only a small portion were in the low category (9.5%). Affected by the burden of work, mental health issues generally originate from Positions such as lathe operators, milling operators, and construction workers. The job involves direct fieldwork and high physical and technical demands, making them more susceptible to work stress.

From 21 main employee factors, which contribute to high Mental workload, are indicators of Temporal Demands *caused* by chasing daily targets, Physical Demands *caused* by heavy physical activity, Effort Level *caused* by high concentration intensity in completing tasks, and Frustration Level *caused* by job uncertainty and accumulation of functions, which are related to deadline pressure and physical and mental work intensity.

To reduce employees' mental workload and increase productivity at CV. XYZ Candi, there are several things the company can do, including evaluating the channels that are available, including distribution, and Task and time management, so that employees do not experience a simultaneous pile-up of tasks. Second, it is necessary to adjust production targets. The determination of daily production targets should be adjusted to employees' actual capacity and working conditions to avoid excessive pressure. Third, training is needed regularly. Periodically, to improve the technical skills and mental capacity of employees so that they can work effectively under pressure. Periodic evaluations using the NASA-TLX method or other methods can help management detect potential problems early and prevent declines in productivity and employee Well-being.

REFERENCES

- [1] 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. <https://doi.org/10.12928/si.v15i2.7554>.
- [2] Pengukuran Beban Kerja Fisiologis dan Psikologis pada Operator Pemetikan Teh dan Operator Produksi Teh Hijau di PTMitra Kerinci. *Jurnal Optimasi Sistem Industri*, 13(1), 503. <https://doi.org/10.25077/josi.v13.n1.p503-517.2014>.
- [3] Ummah, M. S. (2019). Dasar - Dasar Pengetahuan Ergonomi. In *Sustainability (Switzerland)* (Vol. 11, Issue 1).
- [4] 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), 1–6.
- [5] Putri, U. L., & Handayani, N. U. (2019). Angka Kecelakaan Kerja Cenderung Meningkat, BPJS Ketenagakerjaan Bayar Santunan Rp1,2 Triliun.
- [6] Al-Farizi, M., Saputra, F., & Herwanto, D. (2023). Analisis Beban Kerja Mental Menggunakan Metode NASA-TLX pada Divisi Produksi Perusahaan Empat Perdana Carton. *Jurnal Serambi Engineering*, VIII (1), 4521–4528.
- [7] Dahri, A. (2023). Analisis Beban Kerja Mental Dengan Metode NASA-TLX pada Operator Terminal Tractor di PT. Pelindo Terminal Peti Kemas Makassar New Port. *Journal of Social Science Reasearch*, 3(4), 2450–2463. <https://j-innov>.