MENTAL WORKLOAD ANALYSIS USING THE NASA-TLX METHOD IN THE ENGINEERING DEPARTMENT OF PT ABC

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Abstract

This study aims to measure and analyze the mental workload of employees in the Engineering department of a manufacturing company using the NASA-TLX method. The goal is to improve employee welfare and company productivity by identifying factors that cause high workloads and finding the right solution. The method used to determine the value of mental workload of employees in the Engineering department, is measured using the NASA-TLX (National Aeronautics and Space Administration Task Load Index) method. This method measures 6 dimensions of workload measurement, namely, Physical Demand, Temporal Demand, Performance, Effort, and Frustration Level. Most Informants (4 out of 5) experience a high mental workload, marked by a score above 60 on the NASA-TLX scale. The dimensions of "Time Demands" and "Mental Demands" are the main factors that contribute to the high mental workload in the tooling maker section. High mental workload is a serious problem that can have a negative impact on employee health, productivity, and job satisfaction. By implementing the right strategy, companies can reduce mental workload and create a healthier and more productive work environment.

Keywords: Mental Workload, NASA-TLX, Engineering Department

INTRODUCTION

Too easy work makes workers feel bored and unchallenged, while too difficult work can cause excessive physical and mental fatigue. Tarwaka (2015) added that although mental work does not require much physical energy, high cognitive demands can burden the brain and then cause high mental workload. Therefore, it is important to ensure that the mental workload given to workers is in accordance with their abilities, both physical and mental abilities, to prevent fatigue that has a negative impact on worker performance and well-being.

Workload analysis will also help in managing employee work-life balance. By understanding the workload that employees experience, employers can take steps to support a balance between work and life of employee's personal life. This includes flexibility in work schedules, ensuring employees have adequate rest time, and reducing unnecessary stress. By managing workload effectively, companies can achieve increased productivity and overall performance. Employees who work in a less stressful environment tend to be more focused, efficient, and motivated to make maximum contributions. One way to analyze employee workload is to use the NASA-TLX method. The NASA Task Load Index (TLX) is an evaluation tool used to measure the subjective level of workload experienced by individuals when carrying out certain tasks or jobs. NASA-TLX measures the workload level from several relevant dimensions, such as mental fatigue, physical fatigue, tension level, task clarity level, satisfaction level, and success level. This allows for a more holistic understanding of how a particular task affects an individual. Although subjective because it relies on individual perceptions of workload, NASA-TLX can provide relatively objective data.

In an industrial activity, there must also be physical and mental activities. The Engineering department will carry out one of the mental activities. As happened in the engineering department in a toy industry in Serang Regency, or we can call it PT. ABC. The activities that occur in the Engineering department, especially in the tooling maker section, include many things such as ideas and concepts, design and development, manufacturing and production, and innovation and improvement.

Workload analysis is very important in efforts to improve employee productivity and well-being. Workload analysis helps companies identify whether employees are experiencing

excessive workload. This is important because excessive workload can lead to stress, fatigue, and even decreased performance. By recognizing this problem, companies can take steps to reduce the imbalanced workload and prevent its negative impact on employees. By analyzing workload, companies can identify areas where work efficiency can be improved.

In an effort to overcome the problems at PT ABC, the NASA-TLX method has been widely used in various research fields. Such as in the industrial sector, there is a study that This study uses the NASA-TLX method to measure the mental workload of operators on the production floor. The results of the study showed that the highest mental workload occurred at the receiving station (winch rope operator) with a value of 82.33%. The "physical demand" indicator is the most dominant factor in influencing the mental workload of operators (Salman, 2017). Then there is a study using the NASA-TLX and CVL methods to measure the physical and mental workload of operators in the QC department of PT. XYZ. The results of the study showed that the Workload Level (WWL) value for all operators was in the range of 82.67–93.33, which was categorized as "very high" (Fikri and Casban, 2022). In the field of psychology, there is a study using the NASA-TLX method to measure the mental workload of students in completing study assignments. The results of the study showed that the mental workload of students varies depending on the type of task and the level of difficulty of the task (Natasia et al., 2022).

The NASA-TLX method has proven to be an effective tool for measuring mental workload in various fields. The above studies indicate that the NASA-TLX method can be used to identify factors that influence mental workload, evaluate the effectiveness of interventions to reduce mental workload and improve understanding of how mental workload affects individual performance and health. For this study, the researcher will take the title, Analysis of Mental Workload using the NASA-TLX Method in the Engineering Department at PT ABC.

REVIEW OF LITERATURE

Mental Workload

Wignjoesoebroto et al.'s research (2003:118) defined mental workload as a condition experienced by workers in carrying out their duties where there are only mental resources.

Because people's ability to process information is very limited, this will affect the level of performance that can be achieved.

NASA-TLX Measurement Method

The National Aeronautics and Space Administration Task Load Index (NASA-TLX) method is a subjective workload assessment tool developed by NASA to measure mental workload in various types of tasks. This method is widely used in ergonomics, work psychology, and interface design research to evaluate cognitive workload.

The NASA-TLX was developed by Sandra Hart and Lowell Staveland at NASA Ames Research Center in the early 1980s. The goal was to provide a reliable and reasonable tool for measuring the workload perceived by individuals when performing complex tasks, particularly in the context of flight and mission control.

RESEARCH METHOD

The NASA-TLX (NASA Task Load Index) method is a method used to measure mental workload subjectively. The NASA-TLX method uses a questionnaire to determine the mental workload experienced by employees. Although the NASA-TLX questionnaire produces numerical data, technically NASA-TLX analysis is not included in qualitative research. Qualitative research aims to understand the experiences and perspectives of informants in depth. Qualitative research usually produces unstructured data in the form of in-depth interviews, field observations, and field notes. Although NASA-TLX is not considered pure qualitative research, some researchers may use it as part of a mixed research study that combines qualitative and quantitative methods. Researchers may use the NASA-TLX questionnaire to measure mental workload quantitatively. Then, they may conduct interviews with informants to gain a deeper understanding of their experiences and the factors that contribute to their workload. By combining these methods, researchers can gain a more complete picture of mental workload and the factors that influence it.

RESULTS AND DISCUSSION

Overview of Research Subjects

Table 1.
Employee Data Tooling Maker Section

No	Name	Code	Age	Position	Main job
1	Td	Informant 1	42 years old	Technician	Tooling and improvement testing
2	Sc	Informant 2	37 years old	Technician	Tooling and improvement testing
3	Yd	Informant 3	48 years old	Technician	tooling maker
4	Sy	Informant 4	41 years old	Technician	tooling maker
5	Hl	Informant 5	56 years old	Technician	tooling maker

Informant 1 Results (Td)

Table 2.
Results of the Questionnaire for Informant 1 (Td)

Dimensions	Mark	Weight	Workload
Mental Demands	80	4	320
Physical Demands	50	1	50
Time Demands	70	5	350
Performance	40	1	40
Frustration	50	1	50
Business	50	3	150
		WWL Score	**64**

Informant Result 2 (Sk)

Table 3.
Results of the Questionnaire for Informant 2 (Sk)

Dimensions	Mark	Weight	Workload
Mental Demands	70	4	280
Physical Demands	40	1	40
Time Demands	70	5	350
Performance	40	1	40
Frustration	70	1	70
Business	70	3	210
		WWL Score	**66**

Results of Informant 3 (Yd)

Table 4.
Results of the Questionnaire for Informant 3 (Yd)

Dimensions	Mark	Weight	Workload
Mental Demands	80	3	240
Physical Demands	60	1	60
Time Demands	90	4	360
Performance	70	3	210
Frustration	50	1	50
Business	70	3	210
		WWL Score	**75.33**

Results of Informant 4 (Sy)

Table 5.
Results of the Questionnaire for Informant 4 (Sy)

Dimensions	Mark	Weight	Workload
Mental Demands	60	3	180
Physical Demands	60	1	60
Time Demands	60	4	240
Performance	50	3	150
Frustration	50	1	50
Business	50	3	150
		WWL Score	**55.33**

Results of Informant 5 (Hl)

Table 6.
Results of the Questionnaire for Informant 5 (Hl)

Dimensions	Mark	Weight	Workload
Mental Demands	50	2	100
Physical Demands	70	3	210
Time Demands	70	5	350
Performance	40	2	80
Frustration	60	1	60
Business	60	2	120
		WWL Score	**61.33**

Classical Assumption Test

The NASA TLX questionnaire is used to measure mental workload. The data generated from this questionnaire are often used to build a regression model to predict mental workload based on various factors. By conducting a classical assumption test, we can ensure that the regression model we build to predict mental workload is a good and reliable model. The classical assumption test is an important step in regression analysis. Its main purpose is to ensure that the regression model we build is reasonable and reliable. When we use data from the NASA-TLX questionnaire to build a regression model, the classical assumption test is also very relevant. After getting the mental workload score results, the next step is to test the uniformity of the data and the adequacy of the data.

Data Uniformity Testing

Data is said to be uniform if all data is between two control limits, namely the lower control limit and the upper control limit. The formulation of the lower control limit and the upper control limit is as follows (Wignjosoebroto, 2000) for a 95% confidence level→k value = 2, accuracy level 10%→s value = 0.1

$$BKA = \bar{X} + k\sigma$$

$$BKB = \bar{X} — k\sigma$$

Where :

BCA = Upper Control Limit

BKB = Lower Control Limit

$\bar{X}$ = Average value (64.40)

k = confidence level (2)

σ = Standard Deviation (7.31)

Table 7.
BKA and BKB Calculation Results

Informant	WWL Score	$\bar{X}$	σ	BCA	BKB
Informant 1	64.00	64.4	7.31	79.02	49.78
Informant 2	66.00	64.4	7.31	79.02	49.78
Informant 3	75.33	64.4	7.31	79.02	49.78
Informant 4	55.33	64.4	7.31	79.02	49.78
Informant 5	61.33	64.4	7.31	79.02	49.78

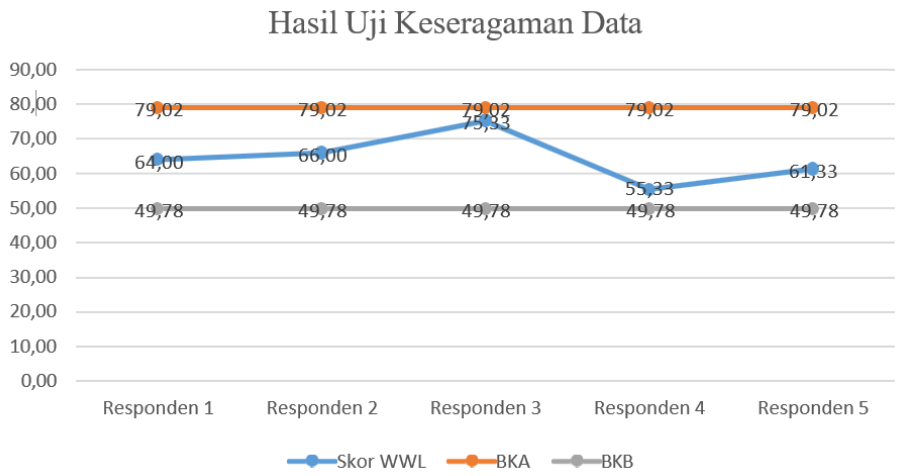

Figure 1.
Data Uniformity Test Graph

From the graph above, it can be seen that none of the WWL score values cross the BKA and BKB lines. This indicates that the data taken is uniform data.

Data Sufficiency Testing

Data adequacy test is conducted to find out whether the amount of observation data is sufficient to conduct research. To calculate the number of measurements required for the level of accuracy required for a level of accuracy of 10% then s = 0.1 and a level of confidence of 95% then k = 2 is as follows (Barnes, 1980):

$$N' = \left[\frac{k/s\sqrt{N(\sum X^2) - (\sum X)^2}}{\sum X}\right]^2$$

Where

N = number of data (5)

(∑ X2) = Sum of Squares of data (20949.39)

(∑ X)2 = Square of the number of data (103667.56)

∑ X = Total data (322)

k = confidence level (2)

s = degree of accuracy (0.1)

$$N' = \left[\frac{2/0{,}1 \times \sqrt{5(20949{,}39) - 103667{,}56}}{322}\right]^2$$

From the calculation of the formula above, it is obtained that N' is equal to 4.13. Because the value of N' < N = 4.13 < 5, the data is considered sufficient to be used as research material.

NASA-TLX WWL Score Results Analysis

In NASA – TLX data processing, the WWL score is obtained from the sum of the weights multiplied by the rating and divided by 15. If the score is between 0-20, the employee is included in the low workload category. A score of 21-40 is in the Medium category, 41-60 is in the rather high category, 61-80 is in the high category and 81-100 is in the very high workload category. The following is a table showing the mental workload categories experienced by the Informant:

Table 8.
Categories of Workload Experienced by Informants

Informant	Dimensions	Mark	Weight	Workload	Score WWL	Category
Informant 1	Mental Demands	80	4	320	**64.00**	**Tall**
	Physical Demands	50	1	50		
	Time Demands	70	5	350		
	Performance	40	1	40		
	Frustration	50	1	50		
	Business	50	3	150		
Informant 2	**Dimensions**	**Mark**	**Weight**	**Workload**	**66.00**	**Tall**
	Mental Demands	70	4	280		
	Physical Demands	40	1	40		
	Time Demands	70	5	350		
	Performance	40	1	40		
	Frustration	70	1	70		
	Business	70	3	210		
Informant 3	**Dimensions**	**Mark**	**Weight**	**Workload**	**75.33**	**Tall**
	Mental Demands	80	3	240		
	Physical Demands	60	1	60		
	Time Demands	90	4	360		
	Performance	70	3	210		
	Frustration	50	1	50		
	Business	70	3	210		
	Dimensions	**Mark**	**Weight**	**Workload**		

Informant 4	Mental Demands	60	3	180	**55.33**	**Some what High**
	Physical Demands	60	1	60		
	Time Demands	60	4	240		
	Performance	50	3	150		
	Frustration	50	1	50		
	Business	50	3	150		
Informant 5	**Dimensions**	**Mark**	**Weight**	**Workload**	**61.33**	**Tall**
	Mental Demands	50	2	100		
	Physical Demands	70	3	210		
	Time Demands	70	5	350		
	Performance	40	2	80		
	Frustration	60	1	60		
	Business	60	2	120		

High mental workload was felt by 4 Informants, while 1 Informant experienced a relatively high workload. This is because Informant 4 felt less experienced compared to other Informants. So the workload received by the Informant was not too high. Sk has a WWL score of 66, which indicates that he experiences a high mental workload. This is mainly due to high mental demands, such as focus and thoroughness in testing and improving tooling, understanding how tooling works and the production process of each product, and analyzing data to solve problems. Yd has a WWL score of 75.33, which indicates that he experiences a very high mental workload. This is due to the complexity of the task, great responsibility, time pressure, and physical demands. Sy has a WWL score of 55.33, which indicates that he experiences a relatively high mental workload. This is due to lack of experience and high time demands. Hl has a WWL score of 61.33, which indicates that he experiences a very high mental workload. This is due to the complexity of the task, great responsibility, time pressure, physical demands, and age.

However, from all the informants, it was shown that the time demand dimension was the dimension that gave the greatest mental workload. This shows that all informants felt pressured by tight deadlines. The mental demand dimension also contributed greatly to the total workload score. This indicates that the work done requires quite high concentration, analysis, and decision making. The physical burden felt by the informants varied quite a bit. Informant 3 had the highest physical burden, while informants 2 and 4 had relatively lower physical burdens. The performance felt by the informants varied quite a bit, but was generally

at a moderate level. The level of frustration also varied, with informant 3 having a relatively lower level of frustration compared to other informants. All informants gave quite high scores for the effort dimension, indicating that they all tried hard to carry out their duties.

Analysis of Each Dimension of NASA-TLX

Based on the NASA-TLX data obtained, here is a summary of the average scores for each dimension and which dimensions contribute the most to the high workload for each Informant. Here is the table:

Table 9.
Total Workload Value and Percentage of Workload Value

Dimensions	Total Workload Value	Percentage of Workload Value
Mental Demands	1120	23%
Physical Demands	420	9%
Time Demands	1650	34%
Performance	520	11%
Frustration	280	6%
Business	840	17%

From the table above, it can be seen that the physical demand dimension is considered the dimension that gives the greatest workload with a value of 1650. Then mental demands are also considered to have a big impact with a value of 1120. Very tight time and work that requires high concentration and thinking processes create a high workload. The dimensions that get the lowest scores are the frustration and physical demands dimensions with an average value of 280 and 420.

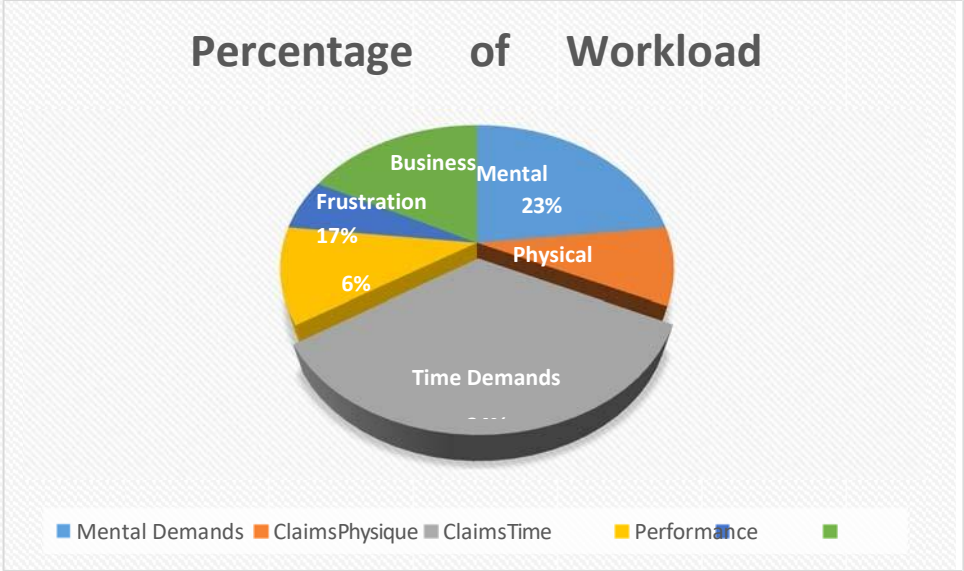

Figure 2.
Diagram of the Sum of the Weights of Each Dimension

Based on the selected dimension weights, the image above shows that time demands are the ones with the highest weighting at 34%. This percentage shows that meeting targets according to the time given also has an effect. At certain times, some employees work overtime to complete unfinished tasks. Followed by mental demands at 23%. This percentage shows that mental abilities such as concentration, accuracy, and planning also have a great influence on the work done. This job requires high accuracy and concentration. Where when the tooling is not made with good quality, it can affect the production results that must be used. Then there is the effort dimension of 17%. Performance at 13%, then Physical Demands and Frustration at 9% and 6%.

The Impact of Mental Workload Experienced by Informant 1 (Td)

Physiological Impacts of continuous high mental workload can trigger chronic stress responses. This can lead to a variety of physical health problems such as headaches, digestive disorders, sleep problems and a weakened immune system. High mental demands can lead to prolonged physical and mental fatigue. This can reduce energy and productivity. High focus and pressure to produce optimal results can cause muscle tension especially in the neck, shoulders and back.

The psychological impact of the demand to always focus and make the right decisions in triggering anxiety. This anxiety can interfere with concentration and interfere with

concentration and the ability to complete tasks. Failure to achieve targets or difficulty in solving problems can cause high frustration. In the long term, excessive mental workload can increase the risk of depression. High workload and constant pressure can reduce job satisfaction and motivation.

The impact of mental workload on performance is a decrease in work quality. When Td feels stressed and exhausted, the quality of work can decrease. This can happen because of more frequent mistakes, less attention to detail, or a decrease in creativity. High mental workload can hinder a person's ability to think clearly and make effective decisions, thus reducing productivity. The stress and frustration experienced by Td can affect his relationships with coworkers and superiors. This can lead to conflict and decreased teamwork.

The high mental workload experienced by Td has a significant impact on both his physical and mental health. This condition not only affects individual performance, but also the quality of the products produced and working relationships with colleagues. Therefore, it is important to find solutions to reduce Td's mental workload and improve his quality of life.

The Impact of Mental Workload Experienced by Informant 2 (Sk)

The physiological impact of the continuous mental workload experienced by Sk can cause prolonged physical and mental fatigue. This can reduce Sk's energy and productivity. Stress from mental workload can disrupt Sk's sleep quality, making it difficult for him to get enough rest and feel refreshed when he wakes up. Chronic stress can weaken the immune system, making Sk more susceptible to disease. In addition, muscle tension due to unergonomic working positions and psychological stress can also cause other physical health problems such as headaches, back pain, and digestive disorders.

The psychological impact of high workload, especially tight time demands, can trigger prolonged stress and anxiety. Sk may feel worried about his ability to complete tasks well and meet set targets. Failure to solve problems or achieve targets can cause high frustration. This can have an impact on Sk's motivation and work spirit. If this condition continues, Sk is at risk of experiencing burnout, a condition of extreme physical, emotional, and mental exhaustion. Burnout can lead to decreased performance, apathy, and even depression.

The high mental workload experienced by Sk has a very significant impact on both his physical and mental health. This condition not only affects individual performance, but also the overall quality of life. Therefore, it is important to find solutions to reduce Sk's mental workload and improve his quality of life.

The Impact of Mental Workload Experienced by Informant 3 (Yd)

Time pressure, complexity of tasks, and great responsibility cause Yd to experience high stress and anxiety. This can interfere with concentration, disrupt sleep patterns, and trigger various other physical health problems. High mental and physical workloads cause Yd to feel constantly exhausted. This exhaustion can reduce productivity and work quality. If this condition continues without intervention, Yd is at risk of experiencing burnout. Burnout is a condition of extreme physical, emotional, and mental exhaustion, which can have serious impacts on health and career.

High mental workload can make it difficult for Yd to make the right and quick decisions, especially in complex situations. Stress and fatigue can lead to errors in work, decreased product quality, and increased risk of work accidents. Chronic stress can weaken the immune system, making Yd more susceptible to disease. In addition, non-ergonomic working positions and noisy and dusty work environments can also cause other physical health problems. The stress and frustration experienced by Yd can affect his relationships with coworkers and superiors.

The Impact of Mental Workload Experienced by Informant 4 (Sy)

Based on the data provided, Sy experiences a significant mental workload, mainly due to lack of experience and high time demands. The demands of learning and adapting quickly to a new job, coupled with lack of experience, can cause Sy to feel stressed and anxious. This can interfere with her concentration and ability to complete tasks well. Lack of experience and comparisons with more experienced colleagues make Sy feel insecure about her abilities. This reduces motivation and work enthusiasm. Difficulty in solving problems and achieving set targets can lead to frustration. This frustration can impact the quality of work and interpersonal relationships.

Stress, anxiety, and lack of confidence can hinder my productivity. It takes me longer to complete tasks than my more experienced colleagues. Due to my lack of experience, I may

make mistakes in my work. This can affect the quality of the product and the company's reputation. I may have difficulty adapting to new work environments and changing job demands.

The Impact of Mental Workload Experienced by Informant 5 (Hl)

Time pressure, complexity of tasks, and great responsibility cause Hl to experience high stress and anxiety. This interferes with concentration, disrupts sleep patterns, and triggers various other physical health problems. High mental and physical workloads can cause Hl to feel constantly exhausted. This exhaustion can reduce productivity and work quality. Difficulty in solving problems or achieving predetermined targets can cause frustration. This frustration can have an impact on Hl's motivation and work spirit.

Stress and fatigue can reduce Hl's concentration and ability to focus on details. This can lead to errors in work and decreased product quality. Chronic stress can weaken the immune system, making Hl more susceptible to illness. In addition, unergonomic working positions and a work environment that may be noisy and dusty can also cause other physical health problems. The stress and frustration Hl experiences can affect his relationships with coworkers and superiors. This can lead to conflict and decreased teamwork. If this condition continues, Hl may become dissatisfied with his job and lose interest in developing.

Proposed Number of Employees Based on WWL Score

Based on the results of the calculation of the mental workload of tooling maker employees, the number of workers needed to complete the work can also be calculated. The following is a calculation of the number of workers needed based on mental load:

Total Workload = 64.00 + 66.00 + 75.33 + 5.33 + 61.33 = 322

Average workload (condition 5 workers) = 322 / 5 = 64.4 (HIGH)

Average workload (recommended 6 workers) = 322 / 6 = 53.66 (SOMEWHAT HIGH)

After calculating the number of employees, namely by dividing the total number of mental workloads by the number of workers (current conditions), the average mental load felt is 64.4. However, if 1 employee is added, the average mental load received is 53.66, which is classified as a fairly high workload. This means that the mental workload experienced by employees is reduced. By adding 1 employee to the tooling maker section,

the mental workload will be spread to more people on the condition that the new employee must be able to adapt quickly to the work environment in the department.

In addition, Informant 4 (Sy) is still less experienced compared to other employees. Therefore, additional training and education are needed to improve his performance. This is expected to help reduce the workload of other employees.

Proposed Improvements for the Mental Demand Dimension

Reevaluate existing work procedures. Identify steps that can be simplified. Detail the specifications of custom-made tooling. Then ensure that all employees have the knowledge and skills needed to perform their tasks. Ongoing training can improve problem-solving skills and reduce uncertainty.

Proposed Improvements for the Physical Demands Dimension

Implement a job rotation system to reduce the physical load on the same body part continuously. Ensure that the workplace is set up ergonomically to reduce the risk of injury due to repetitive movements or uncomfortable body positions. Ensure that there are comfortable rest areas that allow workers to stretch their muscles.

Proposed Improvements for the Time Demands Dimension

Provide flexibility in arranging work schedules, especially for tasks that require high concentration. Help employees prioritize their tasks, so they can focus on the most important tasks first. Set realistic and achievable deadlines.

Proposed Improvements for the Performance Dimension

Provide clear and specific feedback on employee performance, both positive and negative. Ensure that each employee has clear and measurable goals. Provide rewards or recognition for employee accomplishments.

Proposed Improvements for the Business Dimension

Reduce the number of steps required to get approval for a job. Delegate appropriate tasks to other employees to reduce individual workload.

Suggested Improvements for the Frustration Dimension

Open a good channel between management and employees. Create a supportive and collaborative work environment. Allow employees to participate in self-development

programs to improve their skills and knowledge. Having recreation every year can not only strengthen the relationship between employees but also reduce frustration due to work.

Recommendations for Reducing Mental Workload

Based on the above proposals, recommendations can be calculated that can be made to reduce mental workload:

Table 10.
Recommendations for Reducing Mental Workload

No	Recommendation	Recipient	Objective
1	**Re-evaluate tasks and responsibilities:** Conduct an in-depth analysis of each employee's tasks. Identify tasks that can be delegated, simplified, or removed.	The entire management team	Reduce unnecessary workload and distribute tasks evenly.
2	**Training and development:** Provide relevant training to improve employee skills and knowledge, especially in areas that are often a source of stress.	All employees	Increase employee competence, reduce errors, and increase self-confidence.
3	**Task rotation:** Implementation of periodic job rotation programs to provide work variety and reduce boredom.	All employees	Increase motivation and reduce the risk of burnout.
4	**Flexibility of working hours:** Provide flexible work time options, such as flexible hours or working from home, to help employees balance work and personal life.	All employees	Increase employee well-being and reduce stress.
5	**Employee welfare programs:** Hold programs that support employee welfare, such as yoga, meditation, or counseling.	All employees	Helping employees reduce stress and improve mental well-being.
6	**Improve communication:** Improve communication between management and employees to create an open and supportive work environment.	Management and employees	Increase trust and reduce conflict.
7	**Improvement of the working environment:** Make improvements to the physical work environment, such as lighting, ventilation, and ergonomics of work equipment.	Management team	Increaseemployee comfort and productivity.

8	**Periodic performance evaluation:** Conduct periodic performance evaluations to provide constructive feedback and decide on goals. realistic.	All employees	Improve employee motivation and performance.
9	**Providing social support:** Encourage social interaction between employees through joint activities or the formation of work groups.	All employees	Increases a sense of community and reduces feelings of isolation.
10	**Consultation with an expert:** If mental workload problems persist, consider consulting an industrial or organizational psychologist.	Management	Get more specific and comprehensive recommendations.

CONCLUSION

Based on the calculation of mental workload using NASA-TLX, the following is the mental workload score of each informant:

a. Informant 1 (Td) got a mental workload score of 64, meaning that the mental workload is in the HIGH category. The impact is that Informant 1 often experiences headaches, digestive problems, sleep problems, and a weakened immune system. The stress and frustration experienced by Td can affect his relationship with coworkers and superiors.
b. Informant 2 (Sk) got a mental workload score of 66, meaning that the mental workload is in the HIGH category. The impact is that Informant 2 experienced decreased energy and productivity. In addition, Sk's sleep quality was also disturbed by stress, making it difficult for him to get enough rest, and felt unfit when he woke up. In addition, Informant 2 also experienced headaches, back pain, and digestive problems.
c. Informant 3 (Yd) got a mental workload score of 75.33, meaning that mental workload is in the HIGH category. The impact is that Informant 3 experiences prolonged stress and anxiety causing sleep disorders, chronic fatigue, decreased immune system, and potential burnout. Unergonomic working positions and a poor working environment also worsen his physical condition. Concentration is disturbed, it is difficult to make decisions, and high anxiety arises. Chronic stress can also have an impact on interpersonal relationships with coworkers and superiors.

d. Informant 4 (Sy) got a mental workload score of 55.33, meaning that the mental workload is in the QUITE HIGH category. Impact Informant 4 experienced Stress, anxiety, and lack of self-confidence due to lack of experience and comparison with more experienced coworkers. Difficulty in completing tasks, low productivity, and potential for errors in work.
e. Informant 5 (Hl) received a mental workload of 61.33, meaning that the mental workload is in the HIGH category. The impact is that Informant 5 experiences sleep disorders, chronic fatigue, a decreased immune system, and the potential for various other diseases. Unergonomic work positions and poor work environments can also worsen physical conditions. This also causes decreased productivity, poor work quality, and increased risk of errors.

Of the six NASA-TLX dimensions measured, Time Demands is the largest dimension contributing to mental workload in the tooling maker section with a percentage of 34%, then the next dimension is mental demands with a percentage of 23%. Then the Effort dimension is 17%, physical demands are 11%, frustration dimensions are 9%, and finally, performance is 6%.

Suggested mental workload reduction strategies are:

a. Identify steps that can be simplified. Detail the specifications of the tooling that is made to order. Then ensure that all employees have the knowledge and skills needed to perform their tasks. Ongoing training can improve problem-solving skills and reduce uncertainty.
b. Implement a job rotation system to reduce the physical load on the same body part continuously. Ensure that the workplace is set up ergonomically to reduce the risk of injury due to repetitive movements or uncomfortable body positions. Ensure that there are comfortable rest areas that allow workers to stretch their muscles.
c. Provide flexibility in arranging work schedules, especially for tasks that require high concentration. Help employees prioritize their tasks, so they can focus on the most important tasks first. Set realistic and achievable deadlines.

d. Provide clear and specific feedback on employee performance, both positive and negative. Ensure that each employee has clear and measurable goals. Provide rewards or recognition for employee accomplishments.
e. Reduce the number of steps required to get approval for a job. Delegate appropriate tasks to other employees to reduce individual workload.
f. Open a good channel between management and employees. Create a supportive and collaborative work environment. Allow employees to participate in self-development programs to improve their skills and knowledge. Having recreation every year can not only strengthen the relationship between employees but also reduce frustration due to work.
g. Adding 1 employee can reduce the mental workload from 64.4 (HIGH) to 53.66 (SOMEWHAT HIGH). With the addition of employees, the mental workload can be divided among more employees.

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