

## Mental workload analysis using NASA-TASK LOAD INDEX on manual napkin tissue machine in PT. XYZ

Errina Febi Adriyanti \*, Heru Prastawa and Novie Susanto

*Department of Management and Industrial Engineering, Faculty of Engineering, Diponegoro University, Semarang, Indonesia.*

World Journal of Advanced Research and Reviews, 2024, 23(02), 482–487

Publication history: Received on 23 June 2024; revised on 02 August 2024; accepted on 04 August 2024

Article DOI: <https://doi.org/10.30574/wjarr.2024.23.2.2356>

### Abstract

PT XYZ has packer workers tasked with packing tissue on the production floor. In their work, problems often arise related to employees' mental workloads, such as overtime due to irregular working hours, work stress, boredom, accumulation of work, and others. This paper aims to determine the value of mental workload in PT XYZ packer workers and identify factors that cause mental workload so that recommendations for improvement can be given. The subjects of this study were four packers. Data processing was carried out using the NASA - Task Load Index (TLX) method, which has six aspects, namely Mental Demand (MD), Physical Demand (PD), Temporal Demand (TD), Own Performance (OP), Effort (EF), and Frustration (FR). The results showed that two packers had mental workload scores in the high category above 80, with the highest value of 83.6. So that recommendations can be given for improvements to the work environment and company managerial.

**Keywords:** Mental Workload; Packer Workers; NASA-TLX Method; Work Stress; Work Environment Improvements

### 1. Introduction

Human resources are one of the important factors in an organization or company, besides other factors such as assets and capital. [2]

The quality of an organization depends on human resources as the driving force. Workers who have good work performance will provide positive feedback to the company. Therefore, human resource management is needed. Human Resource Management is the process of conveying organizational goals through utilizing humans or people contained therein. Individuals or employees who are managed to have good competencies and abilities needed to support their work. [6]

Human work can be divided into physical work (the use of muscles is more dominant) and mental work (the use of the brain is more dominant). Mental and physical work is intertwined because they are strongly related. Both of these can cause workload. Workers' abilities are higher than their work targets, which can cause boredom, while workers' abilities are lower than their work targets and can cause excessive fatigue.

PT XYZ is a company in the pulp, paper, and converting industry with T tissue as its main product. Some of the brands are Paseo, Jolly, Topy and Nice. Tissue produced by PT XYZ is divided into several categories, namely facial tissue, wet tissue, toilet tissue, towel tissue, and napkin tissue.

\* Corresponding author: Errina Febi Adriyanti

In making napkin tissue, the machine used still operates manually, requiring packer workers to carry out the tissue packaging process. All activities carried out by a packer cannot be separated from the workload. Examples include packing tissue into plastic packaging, sealing plastic packaging, inspecting tissue products, and arranging tissue products into boxes. In carrying out all these activities, high energy and accuracy are required. Coupled with high daily production targets, it will cause a mental and physical workload.

With this research, a mental workload evaluation will be carried out to analyze how much mental workload workers feel when completing the work given by the company. It will also find out what mental workload factors most affect the mental workload of workers. This analysis uses the NASA-TLX method to identify the mental workload experienced by packer workers in the Production Department so that improvements can be made to reduce the impact of mental workload.

---

## 2. Material and Methods

### 2.1. Overview References

#### 2.1.1. Workload

Workload is something that is felt to be beyond the ability of workers to do their jobs. [8] says that workload is something that arises because of the interaction between task demands, work environment, behavioral skills, and perceptions of work. Thus, it can be concluded that workload is a situation where a person is faced with completing work tasks that must be completed within a certain period of time. Workload concerns not only work that is considered heavy but also light work. Workload in the workplace not only involves excess work (work overload) but also includes equal/equal or vice versa lack of work or too low/small work (work underload) [7].

#### 2.1.2. Mental Workload

All mental activities will always involve elements of perception, interpretation, and mental processing of information received by sensory organs to decide or remember past information [5]

There are several symptoms that are the result of mental overload, as explained by [3] namely:

- Physical symptoms: Headache, abdominal pain, easily startled, disturbed sleep patterns, lethargy, stiff neck back to back, decreased appetite, and others.
- Mental symptoms: Forgetfulness, difficulty concentrating, anxiety, anxiety, irritability, irritability, anxiety, and despair.
- Social or behavioral symptoms: Smoking a lot, drinking alcohol, withdrawing, and avoiding.

Several consequences can arise if mental work is poorly designed, such as fatigue, boredom, and lack of accuracy in performing an activity. Other negative effects include forgetting to perform an activity or not performing an activity on time, difficulty concentrating, and difficulty adapting to changing circumstances. Eventually, these will lead to decreased performance, such as increased time while doing work, which will have more fatal effects.

#### 2.1.3. NASA – TLX Method

The NASA-TLX method is a subjective measurement method used to determine the value of mental workload felt by workers in carrying out all activities provided by the company. This method is included in subjective measurements because each respondent fills out a questionnaire according to their feelings when doing their job. Sandra G. Hart from NASA-Ames Research Center and Lowell E. Staveland from San Jose State University developed this method in 1981 based on the emergence of subjective measurement needs consisting of a nine-factor scale which was simplified to 6, namely Mental demand (MD), Physical demand (PD), Temporal demand (TD), Performance (P), Effort (E), Frustration level (FR). The measurement of the NASA-TLX method is divided into two stages, namely, the comparison of each scale (Paired Comparison) and the scoring of work (Event Scoring).

## 2.2. Methodology Study

Data collection was carried out by distributing questionnaires listing questions in accordance with the NASA-TLX method related to aspect weighting and rating to outsourced employees of the napkin tissue packer section of the Production Department and conducting employee interviews regarding work complaints on January 6, 2022 - February 6, 2022.

Furthermore, measurements were made using the NASA-TLX method in the following way [3]:

**Product Value Calculation** The calculation is obtained by multiplying the rating by the weight of each aspect of NASA-TLX. Then, six product values will be obtained, namely MD, PD, TD, OP, EF, and FR.

Product = Rating × Factor Weight

Weighted Workload (WWL) calculation is obtained from the sum of the 6 product values:

$$WWL = \sum \text{Produk}$$

WWL Average Calculation Obtained from dividing the WWL score by the total weight:

$$\text{Score} = \frac{\sum \text{Product}}{15}$$

### 2.3. Score Interpretation

The NASA-TLX score results are divided into five classifications, namely scores of more than 0, Low classification, scores of more than 9, Moderate classification, scores of more than 29, Somewhat High classification, scores of more than 49, High classification, and scores of more than 79, Very High classification [4]. According to [9] the final score of the NASA TLX mental load is obtained by multiplying the weight by the rating of each dimension, then summing and dividing by 15.

## 3. Results and discussion

### 3.1. Data Processing and Analysis

#### 3.1.1. Weighting

At this weighting stage, employees fill out questionnaires and choose aspects of mental workload that are more dominant than other aspects by crossing out aspects that are not dominant. The total pairwise comparison for all dimensions is 15. The number of tally for each dimension will be the dimensional weight. The weighting results can be seen in Table 1.

#### 3.1.2. Rating

In this rating stage, employees fill out a questionnaire and determine the rating of the six aspects of the NASA-TLX mental workload by giving a rating value according to the scale in each aspect. The results of the rating can be seen in Table 1.

#### 3.1.3. Calculation of Mental Workload Score

After the weighting and rating are carried out, the final NASA-TLX score is calculated from the weighted workload (WWL) value divided by the number of weights, which is worth 15. The WWL value is obtained by multiplying the weight by the rating. Each aspect will be summed up later. The NASA-TLX score will then be divided into five categories, namely Low, Medium, Somewhat High, High, and Very High. The results of the NASA-TLX score can be seen in Table 1.

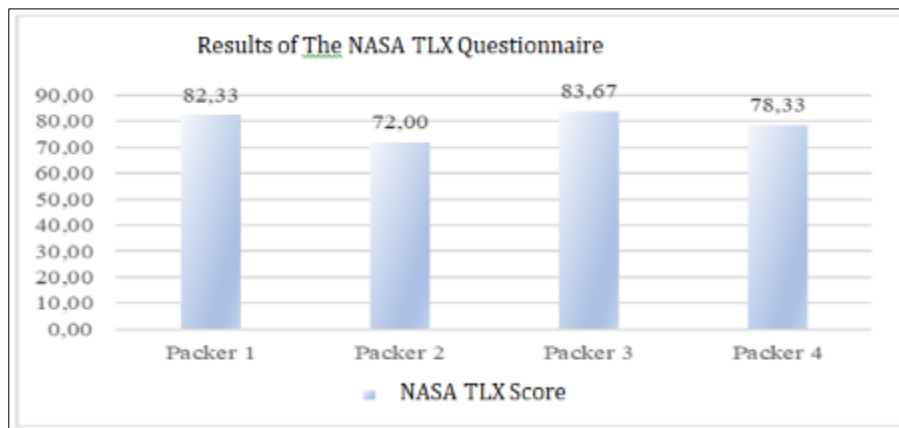
**Table 1** Recapitulation of Mental Workload Measurement Results

No	Position	Category	Weight	Ratings	Product	WWL	Score	Category
		MD	3	95	285			
		PD	4	95	380			
1	Packer 1	TD	2	90	180	1235	82.33	Very high
		P.O	2	10	20			
		E.F	2	90	180			

		FL	2	95	190			
		MD	3	90	270			
		PD	3	95	285			
2	Packer 2	TD	2	100	200	1080	72.00	
		P.O	4	10	40			Tall
		E.F	3	95	285			
		FL	0	80	0			
		MD	3	100	300			
		PD	4	100	400			
3	Packer 3	TD	2	100	200	1255	83.67	Very high
		P.O	3	20	60			
		E.F	2	100	200			
		FL	1	95	95			
		MD	4	90	360			
		PD	3	100	300			
4	Packer 4	TD	2	90	180	1175	78.33	Tall
		P.O	3	15	45			
		E.F	2	100	200			
		FL	1	90	90			

### 3.1.4. Analysis Score of NASA - TLX

Figure Below is the score results from NASA-TLX.



**Figure 1** NASA – TLX Final Score Chart

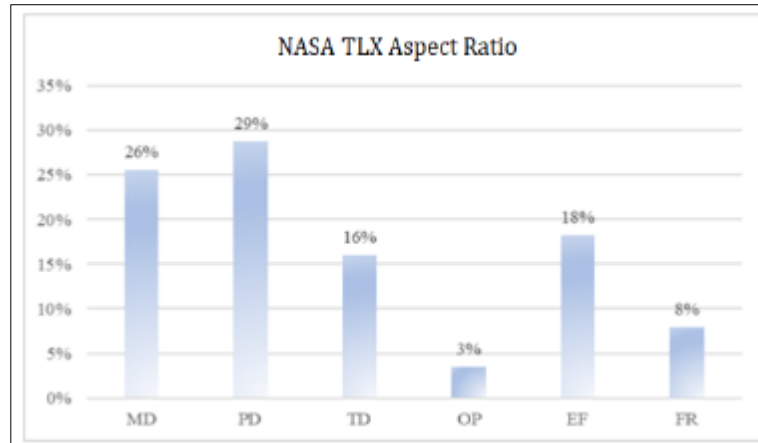
From Figure 1 It can be seen that there are differences in the score results for each packer worker even though the workers performed by each packer are almost the same. This is because the scoring of the NASA-TLX questionnaire is subjective depending on what each packer worker feels. The data is then processed, and the highest NASA-TLX value is 83.67, and the lowest is 72.00.

From the NASA-TLX score graph in Figure 1, it can be seen that the mental workload felt by outsourced workers in the napkin tissue packer section in Department P is still high. This is because of the time pressure when packing tissue and the number of packers, which is only four people. In addition, the high mental workload is also caused by repetitive

work and targets that must be achieved every day. In fact, packers in the Production Division are an important part of the production process at PT. XYZ because the activities carried out are related to the productivity of PT XYZ.

### 3.1.5. Comparative Analysis NASA-TLX Score Elements

The following are the results of the average percentage dimensions NASA-TLX from 4 employees.



**Figure 2** Comparison of NASA-TLX Aspect Percentages

The results of the NASA-TLX score calculation among employees of PT XYZ showed that all employees have a high workload. The order of aspects with the highest percentage is Physical Demand (PD), Mental Demand (MD), Effort (EF), Own Performance (OP), Temporal Demand (TD), and Frustration (FR). The Physical Demand aspect has the highest percentage because packers work in a standing position with repetitive work.

### 3.1.6. Proposed Improvements

The following are proposed improvements to reduce the mental workload felt by PT XYZ packers:

- Change the position of the Air Conditioner so that the air released can be evenly distributed to all employees in the room, and set the optimal temperature. Namely at a temperature of around 24 ° C [1].
- Separate employees should be added to fulfill needs during production, such as taking cardboard and plastic tissue packaging.
- Evaluate the adequacy of the number of workers and add packer employees, especially when the production target is high.
- Organize work rotations and divide shifts fairly so that workers have sufficient rest time to achieve the desired level of productivity.
- Conduct company counseling on a regular basis so that the company can find out about work complaints, work stress, boredom, or loss of work motivation felt by employees.
- Using earplugs when working to reduce noise generated from machine sounds.
- Use gloves, especially when performing the plastic sealing process, to avoid workers' hands coming into contact with the hot sealing machine.

## 4. Conclusion

The conclusions of the research that has been done are as follows:

- Based on the calculation of the NASA-TLX score, it is known that out of 4 employees, there are two employees who have a workload score in the very high category and 2 employees who have a workload score in the high category, with the highest score obtained by packer 3 with a score of 83.67 and the lowest score obtained by packer 2 of 72.00.
- After measuring mental workload, it is found that the most dominant aspects affecting employees are Physical Demand (26%), Mental Demand (26%), Effort (18%), Temporal Demand (16%), Frustration Level (85%), and Own Performance (3%).

- Improvements that can be made by PT XYZ are by evaluating the number of workers, adding workers, providing rest periods, and using PPE when working.

---

## Compliance with ethical standards

### *Disclosure of Conflict of interest*

No conflict of interest is to be disclosed.

---

## References

- [1] American Society of Heating, Refrigerating and Air-Conditioning Engineers. (1995). \*Thermal environmental conditions for human occupancy\* (Standard 55). ASHRAE.
- [2] Hamali, A. Y. (2016). *Pemahaman Manajemen Sumber Daya Manusia*. Yogyakarta: Center for Academic Publishing Service.
- [3] Hancock, P. A., & Meshkati, N. (1988). *Human Mental Workload*. Los Angeles: University of Southern California.
- [4] Hart, S. G., & Staveland, L. E. (1988). Development of NASA-TLX (Task Load Index) Results of Empirical and Theoretical Research. *Advances in Psychology*, 139-183.
- [5] Kroemer, K., & Grandjean, E. (1997). *Fitting The Task to The Human : A Text Book of Occupational Ergonomics (5th Edition)*. USA: CRC Press.
- [6] Suryani, N. K., & John. (2019). *Manajemen Sumber Daya Manusia, Tinjauan Praktis Aplikatif (1st edition)*. Bali: Nilacakra.
- [7] Suwatno, & Priansa. (2014). *Manajemen SDM Dalam Organisasi Publik dan Bisnis*. Bandung: Alfabeta.
- [8] Tarwaka. (2014). *Ergonomi Industri (Dasar-Dasar Pengetahuan Ergonomic Dan Aplikasi Ditempat Kerja)*. Surakarta: Harapan Press.
- [9] Widyanti, A., Johnson, A., & Waard, D. d. (2010). Pengukuran Beban Kerja Mental Dalam Searching Task Dengan Metode Rating Scale Mental Effort (RSME). *J@TI UNDIP (Vol 1)*, 1-6.