
Measurement of Mental Workload Against Packing Operators at UKM Roti Heppy Bakery Padang Using the NASA-TLX Method

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Abstract— In this increasingly advanced era of globalization, more and more manufacturing and service companies are developing which brings intense competition for companies to be able to maintain the company's establishment. IKM Heppy Bakery is one of the bread production companies that is experiencing this competition. For the realization of companies that can compete in the era of globalization, highly competent resources are also needed. The impact of this competition causes more work demands and causes workload effects both physically and mentally on employee performance. Based on this, a mental workload study was conducted to determine the amount of mental workload of employees using the NASA-TLX method. Based on calculations using the NASA-TLX method, it was found that the level of mental workload on bread packaging at IKM Heppy Bakery was included in the very high category with 4 workers having a very high workload category and there were also 2 workers with a high workload category. The average WWL score on bread packaging is 82. For this condition, it is deemed necessary to have an evaluation accompanied by an improvement in the work system or reward to foster motivation and enthusiasm and reduce stress for Heppy Bakery's bread packaging employees.

Keywords : Workload, Mental, IKM ROTI, NASA-TLX..

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1. Introduction

An organization or company is a gathering place for humans who want to achieve a certain goal by limiting existing resources both in terms of human resources and natural resources [1]. All activities carried out to achieve these goals must of course be considered carefully both in planning and in the process [2], [3]. This does not escape the resources needed, how to manage resources to work optimally so that no losses will be borne by the organization or company later. Humans are the main component of human resources in the industrial activities of a company, both manufacturing and service industries [4].

Heppy Bakery is a bread production company which located in West Sumatera and has 20 employees. All activities in the bakery can not be separated from the workload. The number of activities carried out causes high energy expenditure and concentration, causing mental and physical workloads. The activities carried out must be balanced between the mental workload and the physical workload. One of the existing activities is packaging carried out by the packaging department. Workload both mentally and physically with the performance of the bakery packaging operator. Workloads when excessive make fatigue, but workloads that are too light will cause boredom for workers. The workload of a type of work that is borne by a person must be balanced or equal to the abilities possessed, including mental, cognitive abilities, and the limitations of humans who receive it [5]–[7].

The imbalance of the workload received has a negative impact on work results, physical and psychological conditions, such as the results of three previous studies conducted by Bela

Sindy Amelinda et al regarding the analysis of mental load on bakery workers using NASA-TLX in boys cake and bakery [8], then the research that conducted by Riono et al with the title Mental Workload Analysis by integrating NASA TLX and the FUZZY Method [9], and by Peter Hoonaker et al regarding the workload of ICU nurses using NASA TLX [10], [11]. Not only in production company and health care, this method have been used in textile industry [12], [13].

Heppy Bakery's bread packaging has an important role in keeping the bakery company running. This section has the task of packing bread into plastic packaging. Packaging is carried out with the aim of keeping the bread intact and durable until it reaches the point of distribution to consumers. The process of packaging bread with plastic is done manually because the machine for packaging cannot be operated. In the process the operator must ensure that there is no preparation of either the bread or the packaging. This is intended to prevent contamination of the packaged bread which causes the product to be unable to be sold or consumed. Based on the above conditions, it is necessary to find research on mental workload so that later it can be useful for companies to improve the performance of workers in carrying out their activities so that productivity will increase. The research was conducted using the National Aeronautics and Space Administration Task Load Index (NASA-TLX) method. The use of this method because it has been widely used in research on the measurement of mental workload.

2. Research Methodology

The steps involved in conducting this research consist of preliminary observations, problem identification, problem formulation, data collection, data processing, analysis and closing.

Preliminary observations are made to observe the various jobs that exist and the workforce working at the company. The first observation made was to look at the production work from home as well as the operators and workers responsible for the work. Based on observations taken by the author's title regarding the workload that is on the packaging operator at the Heppy Bakery bread house.

Based on observations in the work environment during the last few weeks, identification of problems that will be used as practical work reports, namely an analysis of measuring psychological/mental workloads on packaging operators at Heppy Bakery's bakery using the NASA-TLX method.

The psychological workload data collected came from the results of interviews and filling out questionnaires at the packaging operator at the Heppy Bakery home. After the data collected is met, the next step is to process data, where data processing is carried out based on the results of the weighting questionnaire multiplied by the rating of each scale and the Weighted Workload (WWL) value is calculated. Data processing is done with the following formulas:

$$\text{Product Value} = \text{Rating} \times \text{Working weight} \quad (1)$$

$$\text{Calculation of the Value of Weighted Workload (WWL)} = \sum \text{Product} \quad (2)$$

$$\text{Mean WWL/NASA-TLX Score} = \frac{\text{WWL}}{15} \quad (3)$$

2.2. Analysis

The analysis of mental workload measurement is based on the results of processing the data obtained. The data obtained is then compared with the theory that has been collected in the literature study, so that it becomes an analysis that explains the causes of mental workload on packaging operators at Heppy Bakery's bakery house.

3. Results and Discussion

The results and discussion obtained from data processing are then discussed in terms of measurement results along with the factors that cause mental workload. The following is a discussion of the level of mental workload measurement.

3.1. Measurement of Mental Workload

Based on data processing that has been carried out on 6 respondents who work on bakery packaging at Heppy Bakery, the results of the calculation of metal workloads are high and very high. The following calculations and recapitulation of mental workload are presented in Table 1 until Table 6.

Calculation for respondent 1

Mental Demand (MD)

$$\begin{aligned} \text{Product Value} &= \text{Rating} \times \text{Working weight} \\ &= 79 \times 2 \\ &= 158 \end{aligned}$$

PHYSICAL DEMAND (PD)

$$\begin{aligned} \text{Product Value} &= \text{Rating} \times \text{Working weight} \\ &= 80 \times 3 \\ &= 240 \end{aligned}$$

TEMPORAL DEMAND (TD)

$$\begin{aligned} \text{Product Value} &= \text{Rating} \times \text{Working weight} \\ &= 49 \times 3 \\ &= 147 \end{aligned}$$

PERFORMANCE (OP)

$$\begin{aligned} \text{Product Value} &= \text{Rating} \times \text{Working weight} \\ &= 67 \times 2 \\ &= 134 \end{aligned}$$

FRUSTATION LEVEL (FR)

$$\begin{aligned} \text{Product Value} &= \text{Rating} \times \text{Working weight} \\ &= 49 \times 1 \\ &= 49 \end{aligned}$$

EFFORT (EF)

$$\begin{aligned} \text{Product Value} &= \text{Rating} \times \text{Working weight} \\ &= 79 \times 4 \\ &= 316 \end{aligned}$$

$$\text{WWL} = \sum \text{Product Value}$$

$$\text{Mean WWL} = \frac{\sum \text{Product Value}}{\sum \text{Working weight}}$$

$$\text{Mean WWL} = \frac{1044}{15}$$

$$\text{Mean WWL} = 70 \rightarrow \text{WWL/NASA-TLX Score}$$

Table 1. Calculation for Respondent 2

Indicator	Rating	Weighting	Product Value
MD	80	2	160
PD	80	3	240
TD	85	3	255
OP	90	1	90
FR	95	2	190
EF	95	4	380
WWL			1315
NASA-TLX Score/WWL			88

Table 2. Calculation for Respondent 3

Indicator	Rating	Weighting	Product Value
MD	85	4	340
PD	90	2	180
TD	75	2	150
OP	80	5	400
FR	49	1	49
EF	70	1	70
WWL			1189
NASA-TLX Score/WWL			79

Table 3. Calculation for Respondent 4

Indicator	Rating	Weighting	Product Value
MD	79	2	158
PD	79	4	316
TD	50	0	50
OP	79	2	158
FR	90	4	360
EF	80	3	240
WWL			1282
NASA-TLX Score/WWL			82

Table 4. Calculation for Respondent 5

Indicator	Rating	Weighting	Product Value
MD	79	2	158
PD	79	3	237
TD	50	0	50
OP	79	2	158
FR	90	4	360
EF	80	4	320
WWL			1283
NASA-TLX Score/WWL			82

Table 5. Calculation for Respondent 6

Indicator	Rating	Weighting	Product Value
MD	80	2	160
PD	85	0	85
TD	90	3	270
OP	95	3	285
FR	90	4	360
EF	95	3	285
WWL			1445
NASA-TLX Score/WWL			91

Table 6. Recapitulation of Mental Workload on Bread Packaging at Heppy Bakery's Roti House

NO	Name	Age	WWL	Category
1	Fitria Ramdhani	24	70	High
2	Silvia Yolanda	19	88	Very High
3	Difa Nanda Putri	20	79	High
4	Wita	21	82	Very High
5	Revalen Novian	20	82	Very High
6	Devi Susilawati	18	91	Very High
Average			82	Very High

Based on Table 6, it was found that the average mental workload felt by the packaging section of Heppy Bakery's IKM bread was 82. This value was categorized as a very high mental workload. In addition to the packaging workers there are 2 workers who are categorized as High and 4 workers who are categorized as Very High.

This difference occurs due to other factors such as for example respondent 2 and respondent 6 where for respondent 2 at a relatively young age being a worker is quite difficult for him, this is evidenced by the frustration level (FR) and effort (EF) indicators being the largest score that affects mental workload while for respondents 6 Performance (OP) and effort (EF) most affect mental workload and for other respondents the factors that influence it are different. The value of the WWL score or NASA-TLX score is of course also influenced by the value of each indicator, along with the average value of the ratings of the six indicators presented in Table 7.

Table 7. Rating Each Indicator

Indicator	MD	PD	TD	OP	FR	EF
Avarage	80.3	82.2	66.5	81.7	77.2	83.2

Based on Table 2 indicators Effort (EF), Physical Demand (PD), Performance (OP), Mental Demand (MD) are indicators that are categorized as Very High. The indicator that gets the highest rating and belongs to the very high value classification is Effort (EF) with an average of 83.2. This means that it can be assumed because the operator in completing his job of packing bread requires a lot of effort because it is done manually with a large amount of bread production. The second highest indicator is Physical Demand (PD). This is because packaging operators require high performance because most of the activities carried out are physically and mentally related in packing bread in large quantities, where when packing bread the operator also ensures that there is no damage and ensures the cleanliness of the operator when packing bread, so it takes a good performance so as not to quickly cause fatigue and the work done can

be completed.

The third highest indicator is Performance (OP) with an average of 81.7. This value is included in the very high classification. This is due to the feeling of achievement of the operator's success in completing his repetitive work without using a machine for all bakery products. Next, the Mental Demand (MD) indicator with an average of 80.3. This value is included in the very high classification in fourth place. This is because the work carried out is quite difficult because it requires a high focus when carrying out the packaging process, thus causing high mental preparation as well. The factor of the possibility of work accidents during bread packaging is also the cause of the high rating on the Mental Demand indicator. It is possible for the operator to stand or sit for too long causing injury and repetitive motions without rest.

In addition, the Frustration Level (FR) and Temporal Demand (TD) indicators are also categorized as High. The reason is because work must be done quickly in order to help encourage production activities. For the FR indicator with an average value of 77.2. Operators accept a lot of responsibility where they must be ready to do the job perfectly, because the preparation of preparing bread is good and correct and hygienic because the product produced is a food product. This indicator is also influenced by environmental factors such as a rather cramped environment and insufficient facilities for packaging operators. Then the Temporal Demand (TD) indicator with an average of 66.5. This indicator is ranked last, but this value is still relatively high. This is due to the pressure to quickly complete the queue of the bread packaging process when the bread is experiencing a cooling process for 5 hours, the operator must be able to complete the current queue in order to complete the next queue as much as production is done.

3.2. Improvement Recommendation Analysis

Based on the results of data processing and analysis that has been carried out for measuring the mental workload on packaging at the IKM Roti Heppy Bakery, it is necessary to make improvements to these things, both in the way of working, the work environment and other matters related to the workload of the packaging operator. The recommendations given to IKM Heppy Bakery in an effort to reduce the mental workload of operators are as follows:

1. By adding, expanding or reorganizing the layout of adequate facilities for packaging operators in order to carry out their work optimally,
2. Provide facilities and infrastructure such as tools for the packaging process and prevention of hazards encountered such as masks, gloves and helmets/face shields that are updated regularly and also added to the conditions for this COVID-19, so as not to cause excessive anxiety which can cause operators experience stress and can feel protected, both in terms of health and safety at work.
3. Increase the number of packaging operators to lighten the operator's workload by dividing the total mental workload by the number of operators. Based on the results of the division, the average workload can be obtained. The addition of the number of operators is intended to reduce the average mental workload of workers, so that work will be completed quickly and the mental workload will be smaller.
4. Conduct regular performance evaluations on employee performance.
5. Giving rewards or punishments to employees in accordance with equity theory.

4. Conclusions and Suggestions

The conclusions obtained based on research that has been carried out in measuring the mental workload of workers using the NASA-TLX method on IKM bread Heppy Bakery are as follows: First,

the level of mental workload on the packaging operator of the Heppy Bakery IKM bread is in the very high category with 4 workers having a workload that is in the very high category and there are also 2 workers with a high workload category. The average WWL score for packaging operators is 82, this value is included in the very high category. Second, the highest indicator is obtained from the calculation, namely effort (EF) which is categorized as very high. This indicator shows how much mental and physical work activity is needed to complete work. Third, the lowest indicator is obtained from the calculation, namely temporal demand (TD), but is categorized as high. This indicator shows that the pressure given by time to the completion of the work requires a more competent effort (high focus), on the other hand this work also waits for the cooling process of bread for 5 hours to continue packaging the bread.

Based on the results of the mental workload measurement, it is necessary to improve the load to reduce the mental workload felt by the operator. Recommendations given to the company can be seen in the analysis section on improvement recommendation. The suggestions that can be given for better research going forward is that research should be carried out on all divisions in the company to see which divisions have a high mental workload and find out the causes of the workload of each division and can provide suitable improvements. Then this research can be further developed by using different methods of measuring mental workload, both objective and subjective, and comparing the results obtained from each method used.

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