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WORKLOAD ANALYSIS TO OPTIMIZE LABOR OF TOFU FACTORY X WITH WORK LOAD ANALYSIS AND WORKFORCE ANALYSIS METHODS

Cindy Meisya [1], Nur Fajriah [2], Santika Sari[3]
Universitas Pembangunan Nasional Veteran Jakarta[123],
Jl.RS. Fatmawati Raya, Pondok Labu, Jakarta Selatan[123]
E-mail: cindymeisya05@gmail.com[1] , nurfajriahziah@gmail.com[2], santika.sari@upnvj.ac.id[3]

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ABSTRACT

Tofu factory X is one of the industries in the food sector. This factory processing soybeans into tofu. Tofu factory X is one of the tofu factories located in Depok, West Java. The problems that occur in this factory are the working hours that exceed the normal limit and do not achieve the optimal productivity levels due to the factory's inability to fulfill all demands, for this reason this research aims to calculate the workload of each worker to know the optimal number of workers according to the workload with Work Load Analysis and Workforce Analysis method, after that, a cost analysis is carried out to assist decision making. Based on the results of the analysis, it is found that there are4 workers havead that exceeds the normal limit, there are operator 1 with 124%, operator 4 with 116%, operator 5 with 112%, and operator 7 with 111%. The calculation of the optimal workforce using the Workforce Analysis method shows that the workers of the tofu factory X are advised to add 4 people to each work station with excesworkstationds. Based on the cost analysis, the alternative with the lowest cost was chosen by adding overtime hours with details of the costs that came out per two months amounting to RP.5.271.676.30.

Keywords: ***Workload Analysis, Workforce Analysis, Workload.***

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Fakultas Teknologi Industri
Universitas Muslim Indonesia
Address :
Jl. Urip Sumoharjo Km. 5 (Kampus II UMI)
Makassar Sulawesi Selatan.
Email :
Jiem@umi.ac.id
Phone :
+6281341717729
+6281247526640

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1. INTRODUCTION

Developments in the manufacturing industry are increasing, especially in the food and beverage sector, therefore the companies must be able to manage their management systems appropriately to achieve a high level of productivity so as not to be eroded by competitors. According to (Hatami et al., 2017) the factors that can affect productivity are human resources, work environment, production facilities, and health.

According to (Hermanto & Widiyarini, 2020) the level of worker productivity can be affected by the workload received. To help increase productivity in the human resources section, we have to make some improvements in human resource management. Human resource planning can be done through workload analysis(Hermanto & Widiyarini, 2020).

In this research, the selected object was a small business in the tofu industry namely the Tofu Factory X. This tofu factory is a small business tis hat engaged in the food industry, this factory is located on Jl Sawo 1, Kampung Utan, Depok City, West Java. Production activities at the Tofu X Factory are divided workstationstations, there are milling & cooking, seeding & screening, printing, and cutting & packaging(Wardah, 2017). The main problem that occut the Factory X is a mismatch between the workload received by workers and the number of available workers. This can be seen by the delayed completion time of the working hours thahaveas been set by the company and when the number of workers is reduced due to permits or sick, the factory will reduce the amount he demand production, and it caused the existing demand cannot be fulfilled. This table shows the data wbtained regarding the completion time of the work of the tofu factory X:

Table 1*. Demand Completion Data*

Days to-	Demand	Completion Hours	Working time
1	20618	11 hours	8 hours
2	17300	10 hours	8 hours
3	15700	8 hours	8 hours
4	16440	8 hours	8 hours
5	20488	10.5 hours	8 hours
6	16150	8 hours	8 hours

(Source: Company Data, 2021)

These problems have an impact on the decrease of employee productivity. This table shows the data obtained regarding the targets and the production results of the tofu factory X during the months of January-February 2021:

Sunday	Target	Output	% Productivity
1	106696	98696	93%
2	108998	96268	88%
3	112078	103190	92%
4	112578	99008	88%
5	109980	98500	90%
6	113068	98800	87%
7	114078	105887	93%
8	118578	107733	91%

Table 2*. Demand Completion Data*

(Source: Data Processing, 2021)

Based on table 2, it is found that the level of employee productivity has not been maximized, it can be seen on the percentage of achievements every week does not reach 100%, if this happens continuously the company will suffer losses in the coming year. Therefore, based on these problems, it is necessary to make a han resource planning, through workload analysis, which aims to determine the optimal number of workers and find out the appropriate workload (Marwansyah, 2010). To solve this problem, there are several methods of calculating workloads, one of which is the Work Load Analysis method. With the implementation of Workload Analysis and Workforce Analysis, it is hoped that the problems that occur in the TFactory X can be resolved and the factory can run the business better and compete with other companies.

2. LITERATURE REVIEW

2.1 Workload Analysis

Workload analysis is a process to calculate a person's workload. Workload analysis aims to determine is the workload received is by the ability of the workforce or not. Workload analysis also aims to determination thdetermineorkers needed to complete a job.

2.2 Work Time Measurement

"Work Time Measurement is an activity to determine the time required by a skilled operator to carry out a work activity under normal circumstances (Rustinawati & Lestariningsih, 2021)". The method used in this research is direct measurement of work time with work sampling method. According to (Rustinawati & Lestariningsih, 2021) "Work Sampling is a technique for conducting a large number of observations on the performance activities of machines, processes or workers". The steps in work sampling method are:

1. Conduct preliminary sampling by calculate samples that can be taken in 1 day using the slovin formula (Arifin, 2020)

$$n = \frac{N}{1+Ne^2} \quad (1)$$

n = sample size
N = population size
e = percentage accuracy

2. Determine the random observation time using a random table, in this research a random table was obtained using Ms. Excel.
3. Collecting data on productive and unproductive activities.
4. Calculation the percentage of productive on every worker.
5. Uniformity test and adequacy test.

2.3 Work Load Analysis Method

According to Arif (2008), "Workload Analysis is a way that can be used to calculate the amount of workload caused by the activities". Workload can be seen from the activities carried out by workers in the workplace, either direct activity, indirect activity or other activities, such as personal activities and non-productive activities (Amri, Defi Irwansyah, 2016). This is the formula for calculating workload analysis (Ranupandojo, 1997):

Workload = % productive x Rating Factor x (1+Allowance) (2)

2.4 Workforce Analysis

According to (Komaruddin, 1940:41) "The analysis of workers aims to determine the necessity and personnel, and it can be used to be able to maintain the continuity of the norms of a company's norm activities". In determining the optimal number of workers using workforce analysis, it is necessary to calculate the attendance rate and labor turnover. This is the formula for calculating the number of workers based on workforce analysis: (Heidjrachman, 1990) :

WFA = WLA + (%Attendance x WLA) + (% LTO x WLA) (3)

a. Attendance Rate

According to (Komarudin 1990:23) "The level of attendance is the ratio between the lost working days with the total available working days for work". The calculation of attendance rate is (Ardana et al, 2012:51):

$$\%\text{Attendance} = \frac{Missing\ workdays}{Total\ of\ Working\ days}\ x\ 100\% \quad (4)$$

b. Labor Turnover Rate

Turn over of workers is the flow of incoming workers and outgoing workers of the company, in this case it shows the stability of the workers. The higher the level of turnover rate, the higher the frequency of workers that leaving work. The formula of the calculation of the labor turnover rate is (Ardana etc., 2012:53):

$$\%\ LTO = 100\ x\ \frac{Replacement}{Average\ of\ total\ workers} \quad (5)$$

2.5 Cost Analysis

According to Harnanto (2017) "Cost analysis is needed to interpret the cost information through the accounting system so that it can be used as a basis for consideration in decision making". In this research, a cost analysis was carried out to help determine a decision on the recomendation in costs aspect, there were three recommendation as consideration for decision making, there are additional labor, overtime hours, and subcontracts.

3. RESEARCH METHODOLOGY

3.1 Data collection Procedure

1. Describe every productive and non-productive activity of the workers in accordance with their duties at each work station.
2. Determining a random number in time intervals, in this research the time interval was 5 minutes. The time interval calculation is calculated by the following formula:
   Amount of random numbers
   $$= \frac{Total\ of\ working\ time\ x\ 60\ menit}{\Delta t} \quad (6)$$
3. The slovin method is used to determine the number of samples in the observations as follows: $n = \frac{N}{N\ (d)^2+1}$ (7)
4. Determining the rating factor to ensure the measured workload is in normal conditions, so that the results of the calculations can represent the work system.
5. Determining the allowance so that the calculations are considered relevant or can be said to represent the observed work system
6. Collecting the attendance data from each worker

3.2 Data Processing Procedure

1. Work Sampling
   The first step is to collect data using work sampling technique, by determining productive and non-productive activities with random time. Make a random time for data collection observations with the following formula:
   Observation time 1 = (working hours + (random number x time interval)
   Random number (excel formula) = RANDBETWEEN (0.96) (8)
2. Productive and Non-productive Presentations
   The next steps is to calculate the percentage of productive and non-productive of each worker from the data that has been collected with the following formula:
   % Productive = (number of productive activities)/(Number of observations) x 100% (9)
3. Adequacy Test and Uniformity Test
   Testing the data is carried out with a adequacy test to determine whether the data is adequate

and a uniformity test to determine whether the data is within the lower and upper control limits using Ms. Excel.

4. Workload Analysis
   The calculation of workload analysis is used to determine the workload experienced by the operator, the work is said to exceed the workload if it is above 100%.
5. Workforce Analysis
   Before calculating the workforce, it is necessary to calculate the attendance rate and labor turnover rate.
6. Cost Analysis
   In this research, cost analysis is used to determine the best recommendations with the lowest cost.

4. ANALYSIS AND DISCUSSION

4.1 Proportion Activity Calculation

After collecting data from each operator at each work station, calculations are carried out to calculate the percentage of productive.

Table 3. *Productive Percentage*

Work Station		% Productivity	Average
Milling & Cooking	Operator 1	92%	92%
		90%	
		91%	
		92%	
		94%	
		90%	
		92%	
Filtration & Soaking	Operator 2	77%	75%
		73%	
		77%	
		76%	
		74%	
		77%	
		74%	
	Operator 3	76%	76%
		74%	
		79%	
		77%	
		76%	
		76%	
		73%	
Printing	Operator 4	95%	91%
		92%	
		88%	
		92%	
		90%	
		92%	
		90%	
	Operator 5	88%	89%
		87%	
		90%	
		88%	
		90%	
		88%	
		90%	
	Operator 6	83%	81%
		78%	
		78%	
		78%	
		86%	
		79%	
		85%	
Cutting & Packing	Operator 7	92%	89%
		85%	
		91%	
		88%	
		90%	
		88%	
		90%	
	Operator 8	83%	82%
		86%	
		83%	
		85%	
		77%	
		82%	
		79%	

(Source: Data Processing, 2021)

4.2 Adequacy Test

Table 4. *Adequacy Test*

No	Work Station		N	N'	Results	Information
1	Milling & Cooking	Op 1	546	139.13	N>N'	Enough
2	Filtration & Soaking	Op 2	546	533.33	N>N'	Enough
3		Op 3	546	505.26	N>N'	Enough
4	Printing	Op 4	546	158.24	N>N'	Enough
5		Op 5	546	197.75	N>N'	Enough
6		Op 6	546	375.31	N>N'	Enough
7	Cutting & Packing	Op 7	546	197.75	N>N'	Enough
8		Op 8	546	351.22	N>N'	Enough

(Source: Data Processing, 2021)

In the table above, it can be seen that the data taken for each operator shows N > N', therefore the data can be said to be sufficient, and the data can be used for further data processing.

4.3 Uniformity Test

Table 5. *Uniformity Test*

No	Work Station		% Pro-ductive	BKA	BKB
1	Milling & Cooking	Operator 1	92%	0.97	0.85
2	Filtration & Soaking	Operator 2	75%	0.85	0.65
3		Operator 3	76%	0.85	0.66
4	Printing	Operator 4	91%	0.97	0.85
5		Operator 5	89%	0.96	0.81
6		Operator 6	81%	0.90	0.72
7		Operator 7	89%	0.96	0.82

8	Cutting & Packing	Operator 8	82%	0.90	0.73

(Source: Data Processing, 2021)

Based on the calculation results, it can be seen from the graphs above that from the data obtained for the 8 operators as research objects, none of them crossed the upper limit (BKA) or lower limit (BKB), therefore the data taken in this research can be said to be uniform.

4.4 Work Load Analysis

Table 6. *Workload Analysis*

No	Work Station		%Prod x RF	1+All	WLA
1	Milling & Cooking	Operator 1	102%	122%	124 %
2	Filtration & Soaking	Operator 2	79%	121%	95%
3		Operator 3	80%	121%	96%
4	Printing	Operator 4	101%	114.00 %	116 %
5		Operator 5	99%	114.00 %	112 %
6		Operator 6	85%	114.00 %	97%
7	Cutting & Packing	Operator 7	99%	112%	111 %
8		Operator 8	86%	112%	97%

(Source: Data Processing, 2021)

The result of Workload (WLA) calculation show that operator 1, operator 4, operator 5, and operator 7 have workload overload with a percentage of 112% to 124%. And for operator 2, operator 3, operator 6, and operator 8, the workload does not exceed 100%, it means that the workload on these operators is normal. For this reason, it is necessary to adjust the workload of each worker whose workload exceeds the normal limit.

4.5 Workforce Analysis

- Attendance Rate

Table 7. *Attendance Rate*

No	Month	Total workers	Working days	Days of Absent	Days of Attended
1	August	8	200	1	199
2	Septemb	8	200	4	196
3	October	8	208	3	205
4	Novemb	8	200	6	194
5	Decemb	8	208	4	204
6	January	8	200	6	194
7	February	8	192	6	186
8	March	8	216	4	212
9	April	8	208	3	205
10	May	8	168	2	166
Total		80	2000	39	1961

(Source: Data Processing, 2021)

The calculation of the percentage of labor attendance is calculated by the following formula:

% Attendance
= (Missing Workdays)/(Total Number of Working Days) x 100%
= 39/(1961+39) x 100% = 1.95%

The calculation results of the percentage of attendance show that the absenteeism rate at The Factory X for 10 months is 1.95%.

- Labor Turnover Rate

After interviewing the owner of the Factory X, it was obtained that there were some workers who left for a period of 10 months, 2 workers in March, then replaced by 2 new workers in April. The factory does not have a labor turnover because the labor that leaves and enters the factory is still within reasonable limits and the number employees does not change. Therefore, the labor turnover rate of Tofu Factory X is 0%.

- The Calculation of Workforce Analysis

No	Work Station		WFA	
1	Milling & Cooking	Operator 1	1.2591105	2
2	Filtration & Soaking	Operator 2	0.973348	1
3		Operator 3	0.978073	1
4	Printing	Operator 4	1.1790249	2
5		Operator 5	1.145946	2
6		Operator 6	0.9901306	1
7	Cutting & Packing	Operator 7	1.1304843	2
8		Operator 8	0.9859349	1

Table 8. *Calculation of Workforce Analysis*

(Source: Data Processing, 2021)

- Number of Labor and Labor Arrangement

The calculation results show that 4 people must be added, there are 1 person at the milling & cooking work station, 2 people at the printing work station, and 1 person at the cutting & packing work station

4.6 Cost Analysis

1. Additional Labor Cost

Labor cost/month = Rp. 3,000,000.-
Difference in labor costs for 1 month
= Rp.36,000,000 – Rp.24,000,000
= Rp.12,000,000

If we were compared this result with the loss for 1 month in January which is Rp. 34,550,400, adding 4 people to work with an additional cost of Rp.

12,000,000 will be much better than reducing the amount of production, because it can avoid losses.

2. Overtime Fee
   Overtime fee = 1/173 x Rp.3,000,000
   = Rp.17.341.04
   First hour overtime fee =
   Rp.17,341.04 x 1.5 = Rp.26.011.56
   Overtime fee for the next 1 hour
   = Rp.17,341.04 x 2 = Rp.34,682.08

Table 9. *Overtime fee*

Number of weeks	Excess Demand	Overtime hour	Overtime Fee	Overtime Fee of 8 workers
1	80	2	Rp60,693.64	Rp485.549.13
2	127.3	3	Rp95,375.72	Rp.763.005,78
3	88,88	2	Rp60,693.64	Rp485.549.13
4	135.7	3	Rp95,375.72	Rp.763.005,78
5	114.8	3	Rp95,375.72	Rp.763.005,78
6	142.68	3	Rp95,375.72	Rp.763.005,78
7	81.91	2	Rp60,693.64	Rp485.549.13
8	108.45	3	Rp95,375.72	Rp.763.005,78
Average overtime cost/week				Rp.658.959.54
Overtime Fee / 2 months				Rp.5,271,676.30

(Source: Data Processing, 2021)

It can be seen that the factory must spend Rp. 5,271,676.30 if applying overtime hours for 2 months.

3. Subcontract Fee

Table 10. *Subcontract Fee*

1	8000	Rp700	Rp5,600,000
2	12730	Rp700	Rp.8,911,000
3	8888	Rp700	Rp.6.221.600
4	13570	Rp700	Rp9,499,000
5	11480	Rp700	Rp8.036.000
6	14268	Rp700	Rp9.987.600
7	8191	Rp700	Rp5,733,700
8	10845	Rp700	Rp7,591,500
Total			Rp. 61,580,400

(Source: Data Processing, 2021)

From these data, it is found that if the factory does sub-contract, the costs incurred within 2 months are Rp. 61,580,400.

5. CONCLUSION

From the measurements and the calculations, it can be concluded that:

1. The results of the workload calculation using the workload analysis method on workers at the Tofu Factory X showed that there were 4 operators that have excessive workloads because the results of the workload calculations exceeded the normal limit, which was above 100%. At the milling & cooking work station, operator 1 has a workload of 124%, at the printing work station there are 2 workers with excess workload, there are operator 4 at 116% and operator 5 at 112%, and at the cutting & packing work station operator 7 has a workload at 111%. The other 4 workers did not have an excessive workload, the results ranging from 95%-97% for operator 2, operator 3, operator 6, and operator 8.
2. Based on the calculation results of determining the optimal number of workers using the workforce analysis method, it is known that the percentage of absenteeism at the Tofu Factory X is 1.95% and because the factory does not have a labor turnover, the LTO percentage is 0%. The results of the WFA calculation show that the factory must add 4 workers, with details of adding workers at the milling & cooking work station adds 1 workers, the printing work station adds 2 workers with a total workers of 5 people, and at the cutting & packing work station, it is recommended to add 1 person. Therefore, the optimal number of workers at Tofu Factory X is 12 people.
3. Cost analysis as an alternative for factories in choosing decisions for productivity achievement is carried out to obtain minimum costs in order to help reduce factory expenses. The results of the cost analysis show that the alternative that can be chosen with the lowest cost is to apply time and rules for overtime hours, where the costs incurred for 2 months are Rp. 5,271,676.30. The addition of overtime hours will also be more effective and efficient because it will reduce training time and costs.

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