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WORK SAMPLING METHOD FOR ANALYSIS OF PERFORMANCE AND DETERMINING THE NUMBER OF WORKERS IN THE WAREHOUSE DEPARTMENT

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Abstract: *Industrial competition demands that each company be effective and efficient, hence companies need to make optimal use of resources. The purpose of this research is to determine the productivity of the workers in completing their work and to discover how much workload is caused by the activities carried out. In addition, recommendations for improvements were also given as an effort to reduce the high rate of overtime hours and determine the appropriate number of the workforce at spare parts and raw materials division. The results showed that some workforces have an uneven workload. Meanwhile, based on the results of workload analysis, it can be seen that the workload of the warehouse feeder is classified as a high workload, which is 102%.*

Keywords*: work sampling, workload analysis, productivity, standard time*

1. Pendahuluan

The intense competition in the industry requires companies to compete in producing the best products by utilizing resources optimally. The company must have the ability to increase its various production activities, in producing a product that requires time in each of its production activities. However, it is not only workers who can be measured. The measurement of working time is used to get the standard time that must be achieved by workers in completing a job. Every job has a standard time and different workload sizes depending on what job they are doing. Time is one of the main criteria in increasing production. It is very important to know the measurement of the work time required by workers to complete the work.

The workload is a worker's physical ability to accept work, from an ergonomic point of view, each workload of a job that is done must be balanced and in accordance with the workers' physical and psychological abilities [1]. The physical workload referred to, among others, is in the form of work that uses the power of workers who lift, encourage, care for psychological workloads, including workload related to the level of expertise and achievement of workers with other workers (Tarwaka et al., 2004). Unbalanced or too high workloads can result in excessive working hours so that workers need overtime to complete their work. Each company must have determined the amount of overtime provided for each job, overtime working hours that exceed 8 hours in one day. However, because the workload is too high, the work can exceed the limit of the set working hours resulting in overtime. Research on workload is carried out to see how much workload for each worker to complete his work efficiently and effectively and also how much workforce is optimal for completing work in order to reduce excess overtime hours.

The research was conducted at a company that operates in the field of animal husbandry and cow's milk processing factory in Malang City. This company produces its own livestock by developing more than 6,000 head of Friesian Holstein cattle which were founded directly from Australia and for bull cattle sperm are imported from quality cows in the United

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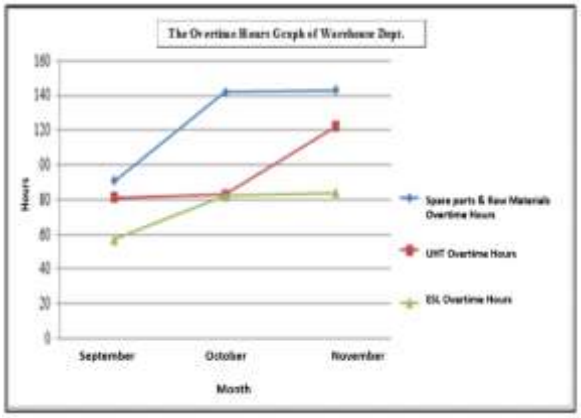
States. The result of this artificial insemination has enabled the industry to produce high-quality milk and has been exported to several countries. This proves that this industry is already competitive in the international arena. This industry produces pasteurized milk and UHT milk in several types of flavours with different packaging sizes. Apart from that the company also produces whipped cream, skim milk, yoghurt and cheese.

In carrying out the milk processing process, the company has used an integrated machine operated by a human workforce. In realizing the company's goals, such as efficiency in production, this company also needs to pay more attention to its workforce as an effort to support the company's long-term plan to make it happen. Therefore, this company must set standard time and workload for each job.

One of the divisions that have an important role to support the company's production process is the logistics or warehouse division. The warehouse is part of the company's logistics system that stores products (raw materials, parts, goods-in-process, finished goods) at and between the point of source and point of consumption, and provides information to management regarding the status, condition, and disposition of items [2].

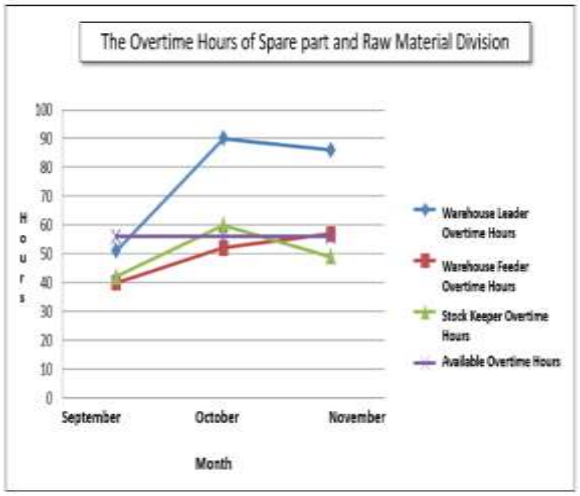
The warehouse division at this company does not yet have a standard time in its work activities, so work measurements are needed to find out the standard time for workers to complete their work and to find out whether workers have used work time optimally or the number of workers is not in accordance with what is needed. Figure 1 shows the total data of several sections in the warehouse/logistics department from September to November 2018.

The UHT section has 2 work shifts, the ESL section has 3 work shifts, while the spare part and raw material section only has 1 work shift. Among the three parts, spare parts and raw material have the highest overtime rate. This section has 1 operator and 1 warehouse leader.



Picture 1. Overtime Hours Warehouse Dept. Graphic

Based on the decree of Indonesia Minister of manpower and transmigration no. 120 of 2004 in article 3 states that the maximum limit of overtime hours in 1 week is 14 hours and in 1 month does not exceed 56 hours per month for one employee. Overtime hours data from the warehouse leader, stock keeper, and warehouse feeder in the spare part and raw material section is shown in Figure 2.



Picture 2. The Overtime Hours of Spare part and Raw Material Division

From Figure 2, it can be seen that the overtime hours for spare parts and raw materials in the logistics department are more than 56 hours per month. Therefore, this section has a high overtime rate.

Work on spare parts and raw materials is done by 1 warehouse leader, 1 stock keeper, and 1 warehouse feeder. Where based on the results of interviews with warehouse leaders and

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operators, they did quite a lot of work to be handled simultaneously so that they had to work beyond predetermined working hours. Based on this, it is necessary to measure the working time. Work measurement is a measurement of work time (time study) of an activity carried out for productivity and to find out how much workload [3].

Table 1. Pre-Observation Results (*Pre-Work Sampling*)

No.	Position	% Productive Time	% Non-Productive Time
1.	*Warehouse Leader*	74%	26%
2.	*Stock Keeper*	75%	25%
3.	*Warehouse Feeder*	79%	21%

Table 1 is pre-work sampling data conducted on warehouse leaders, stock keepers, and warehouse feeders to determine the percentage of productive and non-productive time in spare parts and raw materials. Observations of pre-work sampling were carried out 300 times at random times, where observations were made at 08.00-16.00 or normal working time. Workers are considered productive when working in accordance with the job description, while workers are said to be unproductive when carrying out activities outside of the job description. It can be seen in Table 1 that the results of the pre-work sampling show the percentage of non-productive workers is above 20%. This happens because there is idle, which should be more optimized.

The work sampling method is used to take measurements directly on the object of research. Furthermore, from the measurement with the work sampling method, the productivity of workers in completing their work will be known, and the standard time to complete a work cycle will be obtained, which is used as the standard time for completing work for all workers with the same type of work. The results of the work sampling method are then used to calculate the workload using the workload analysis (WLA) method. Workload analysis is a method used to calculate how much workload is caused by the activities carried out [4].

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2. Method

This study uses a work sampling method to obtain workload calculations. Data processing begins with the collection of data on the percentage of productive and non-productive activities of workers while doing their job.

A total of 700 data were observed from 100 visits conducted for 7 hours a day starting from 08.00 WIB to 16.00 WIB, with breaks starting at 12.00 WIB to 13.00 WIB.

The method of data collection from this work sampling is collected according to random times, then research is carried out to observe the activities of workers in the warehouse section according to a predetermined random time.

Table 2 explains that from 700 observational data carried out at the warehouse leader, there were 543.21 productive activities outside the job description and 136 unproductive activities. Meanwhile, in the warehouse feeder, there were 572.3 productive activities outside the job description and 125 unproductive activities. For stock keepers, there were 545.10 productive activities outside the job description and 145 non-productive activities.

3. Results

From all observations to all operators, the amount of observation data carried out on one worker is 700 data. The total data that has been taken is 2100 data. Then, determine the number of productive percentages and productive observations.

The number of overall productive observations:

$= \frac{1660}{2100}$ x 100% = 78,7%

Percentage of productive warehouse leaders:

$= \frac{518}{700}$ x 100% = 74%

Percentage of productive stock keeper:

$= \frac{545}{700}$ x 100% = 77,9%

Percentage of productive warehouse feeder:

$= \frac{591}{700}$ x 100% = 84,4%

Next, determine the number of minutes of observation that have been made during the observation.

The number of minutes of observation:

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= 7 hours' x 7 visits x 60 minutes
= 2940 minutes.

It is known that the number of outputs from the warehouse leader and stock keeper is 25 shipments and 12 loading and unloading. Meanwhile, 55 Warehouse feeders are used for loading and unloading (both from spare parts and raw materials as well as the addition of packaging).

The next step is to calculate the cycle time, normal time, and standard time:

Warehouse leader cycle times

$= \frac{2940 \times 0.74}{37} = 58{,}860$ menit

Stock keeper cycle times

$= \frac{2.940 \times 0.779}{37} = 61{,}898$ menit

Warehouse Feeder cycle times

$= \frac{2.940 \times 0.84}{55} = 44{,}902$ menit

Warehouse leader normal time

$= \frac{2940 \times 0.776 \times 1{,}00}{37} = 58{,}860$ menit

Stock keeper normal time

$= \frac{2940 \times 0.779 \times 1{,}00}{37} = 61{,}898$ menit

Warehouse feeder normal time

$= \frac{2940 \times 0.817 \times 1{,}00}{55} = 44{,}902$ menit

Calculating the standard time by entering a predetermined allowance factor.

Warehouse leader standard time

$= 58{,}860$ menit x $\frac{100\%}{100\%-21\%} = 74{,}50$ menit

Stock keeper standard time

$= 61{,}898$ menit x $\frac{100\%}{100\%-20\%} = 77{,}37$ menit

Warehouse feeder standard time

$= 44{,}902$ menit x $\frac{100\%}{100\%-21\%} = 56{,}837$ menit

After all the time calculations are known, the next step is to calculate the workload of all workers in the spare parts and raw material warehouse.

Workload = (%productive activities x *performance rating*) x (1 + *allowance*)
Warehouse leader workload = (0.776 x 1.00) x (1 + 21%) = 0.895
Stock keeper workload = (0.779 x 1.00) x (1 + 20%) = 0.935
Warehouse feeder workload = (0.844 x 1.00) x (1 + 21%) = 1.02

Table 2. Observation Data Results in 7 Visits

Worker Activities	Visits Order							∑
	1	2	3	4	5	6	7	
Productive *Warehouse leader*	74	75	67	73	72	81	76	518
Productive not-suitable with *job description*	8	6	7	6	5	6	5	43
Non- Productive *Warehouse leader*	18	19	26	21	23	13	19	139
Total	100	100	100	100	100	100	100	700
Productive *Warehouse feeder*	84	86	79	81	83	90	88	591
Productive- not suitable with *job description*	0	0	0	0	0	0	0	0
Non-Productive *Warehouse feeder*	16	14	2 1	19	16	10	13	109
Total	100	100	100	100	100	100	100	700
Productive *Stock keeper*	75	79	75	78	74	82	82	545
Productive not suitable with *job description*	2	0	0	3	5	0	0	10

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Non produktif *Stock keeper*	23	21	25	19	21	18	18	145
Total	100	100	100	100	100	100	100	700

Before testing the adequacy of data and data uniformity, the percentage of productive for each worker is first calculated. Productive is the working time used by the operator when working according to the job description or not, if it is not suitable then it is considered non-productive.

Table 3. Warehouse Leader Average Productivity Data

Visits Order	Warehouse Leader			Sum	%p
	Productive Activities	Productive not suitable with *job description*	Non-Productive Activities		
1	74	8	18	100	0,74
2	75	6	19	100	0,75
3	67	7	26	100	0,67
4	73	6	21	100	0,73
5	72	5	23	100	0,72
6	81	6	13	100	0,81
7	76	5	19	100	0,76
Average					0,74

From the observations of warehouse leader productivity in Table 3, the productivity obtained is 0.74 out of 700 observations made. This is because there are still quite a lot of non-productive activities carried out by warehouse leaders.

Tabel 4. Stock Keeper Average Productivity Data

Visits Order	Stock Keeper			Sum	%p
	Productive Activities	Productive not suitable with *job description*	Non-Productive Activities		
1	75	2	23	100	0,75
2	79	0	21	100	0,79
3	75	0	25	100	0,75
4	78	3	19	100	0,78
5	74	5	21	100	0,74
6	82	0	18	100	0,82
7	82	0	18	100	0,82
Average					0,779

Table 4 shows that the average percentage of stock keepers is 0.779 out of 700 observations made. This is because there are still quite a lot of non-productive activities carried out by stock keepers while working.

Table 5. Warehouse Feeder Average Productivity Data

Visits Order	Warehouse Feeder			Sum	%p
	Productive Activities	Productive not suitable with *job description*	Non-Productive Activities		
1	84	0	16	100	0,83
2	86	0	14	100	0,81
3	79	0	21	100	0,79
4	81	0	19	100	0,81
5	83	0	16	100	0,8
6	90	0	10	100	0,86
7	88	0	13	100	0,82
Average					0,844

Table 5 explains that the warehouse feeder average percentage is 0.84 out of 700 observations made. It can be seen that the productive percentage in the warehouse feeder is greater than the warehouse leader and stock keeper, but this still shows that there are still non-productive activities carried out by warehouse feeders when they are workers.

5. Discussion

The result of the largest percentage of productive activities was obtained by warehouse feeder 84.4% with productive activities of 591

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and 109 non-productive activities, warehouse leaders had a productive percentage value of 74.6% with productive activities of 518 and non-productive activities of 157, stock keepers had a percentage value productive 77.9% with productive activities as many as 545 and 145 non-productive activities.

The difference in the productive percentage value of each worker is due to different positions and also the number of non-productive activities that are obtained when making observations. For warehouse feeder, it has the largest percentage value of productive because it delivers packaging to the production warehouse instructed by the packaging foreman. This is because the goods are stored in the spare parts and raw material warehouse. So that it affects the value of the percentage of productive warehouse leader for spare parts and raw material warehouse. The productive percentages of warehouse leaders and stock keepers that have been obtained are 74% and 77.9% due to a process that is hampered due to a lack of workers so that there is idle in the loading and unloading process so that it affects the standard time in normal working hours and productivity.

Meanwhile, for the calculation of work sampling to warehouse workers for spare parts and raw materials, the standard time for each worker is obtained. From the data that has been taken, then the data uniformity test and the data adequacy test are carried out to ensure that the data is uniform and sufficiently represents the actual situation. After testing the uniformity and adequacy of the data, then the standard time calculation for each worker is carried out to complete the warehousing activities, namely the delivery of goods and also the unloading of the truck to be stored in the warehouse. The standard time obtained for the warehouse leader in the shipping and loading and unloading processes is 74.50 minutes for one delivery and loading and unloading process, the stock keeper gets a standard time of 77.37 minutes, and warehouse feeders get a standard time of 56,837 minutes for one-time shipment or loading. For the average warehousing process in one day during the observation, there were 5 processes for the warehouse leader and stock keeper. So that the time obtained is 372.5 minutes a day for the warehouse leader, 386.85 minutes for the stock keeper.

In contrast to the warehouse feeder which has an average of 8 times the warehousing process so that the results are 454,696 minutes a day. From these results, the company has a working time of 7 hours or 420 minutes so that the warehouse feeder has a standard time that exceeds the predetermined working time. However, the standard time obtained from the warehouse leader and stock keeper for 7 normal working hours is that there are still unproductive activities because the loading and unloading process is hampered so that it is carried out during overtime, it occurs because of a lack of workers to assist the loading and unloading process so that the process is hampered.

Furthermore, in calculating the workload of each worker, different workloads are obtained for each worker depending on the percentage of productive and also the performance rating and allowances.

The workload for the warehouse leader is 89%, the stock keeper has a workload of 93%, and the warehouse feeder has a workload of 102%. Normal workload has a percentage value of 100% if it is above 100% then it has a high workload, it can be seen that the workload percentage of the warehouse feeder has a high workload of 102% and the warehouse leader has a low level of workload among employees. another is 89%.

For the calculation of the number of workers in a warehouse feeder, it is done using the warehouse feeder workload percentage. After the calculation is done by increasing the number of workers to 2 people, the percentage of workload becomes 51%. This calculation is considered the ideal workload percentage because it does not exceed 100%.

5.1. Recommendations

To improve the productivity of workers in spare parts and raw material warehouses, this is done by reducing idle while working. For example, warehouse leaders and stock keepers have a low percentage of productivity. This low productivity is due to workers doing work in a hurry. Another reason is when the loading and unloading process activities are carried out

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simultaneously. The loading and unloading process must wait for the delivery process to be carried out first by the warehouse feeder.

There is only one warehouse feeder in the spare parts and raw material warehouse, when that happens the warehouse leader and stock keeper become idle. Therefore, one helper is needed to assist the loading and unloading process at the spare parts and raw material warehouse. Helpers are used instead of adding workers because the productivity and workload of the warehouse feeder will decrease and become less than optimal. Another problem is the overtime hours that are quite often done by warehouse leaders due to idle during the loading and unloading process which will be resolved. So the helper solution is considered quite effective because it will speed up the loading and unloading process and increase the productive percentage for 7 hours of work.

The second recommendation is the calculation of standard time. The standard time obtained from the warehouse feeder in this study exceeds the provided working hours, namely 420 minutes per day, while the standard time from the warehouse feeder is 442.248 minutes. So that it proves that workers complete their work in a hurry to fit the available working hours and also the amount of work that must be done both shipping and loading and unloading, this is in accordance with the real conditions at the time the observations were made. In the warehouse feeder, shipping and loading and unloading apart from the spare parts and raw material warehouse, namely from the packaging section because there are goods stored in the spare parts and raw material warehouse. So the recommendation that can be suggested is to add more helpers and also reduce the personal allowance of workers.

Next are some recommendations for improvements to workload problems, namely:
1. Warehouse feeder has a high workload due to additional loading and unloading activities by the packaging party. Within 7 days of observation there were 18 out of 55 loading and unloading activities which were additions from the packaging party. Therefore, the recommendation from the researcher is to add workers for separate packaging parties related to goods delivery and loading and unloading activities. That way the workload of the warehouse feeder, spare parts and raw material parts can be reduced. In order for a warehouse feeder to have an ideal workload, it must divide the work according to the tasks previously given to the warehouse feeder. With the presence of 2 warehouse feeder workers, the division of job descriptions can be seen in table 6.

2. For warehouse leaders, productive and unproductive data collection occurs, but not in accordance with the job description, it is carried out to assist in loading and unloading activities by helping to put goods from trucks onto pallets so that it is more optimal to load goods into the warehouse. Because the workload of the warehouse leader is 89%, you can increase the workload by entering these activities in the job description, which is helping the loading and unloading process of goods into the warehouse. The following are the results when adding to the job description and recalculating using the work sampling formula and workload analysis, the productive percentage is 80.1%, the standard time is 80.565 minutes and the workload increases by 96.9% with the difference in the increase from the previous workload. by 0.74%.

6. Conclusion

Based on the calculation of work sampling, the standard time obtained in the warehousing process is loading and unloading, the warehousing process in one day while carrying out observations obtained as many as 5 processes for warehouse leader and stock keeper. So that the time obtained is 372.5 minutes a day for the warehouse leader, 386.85 minutes for the stock keeper. In contrast to the warehouse feeder which has an average of 8 times the warehousing process so that the results are 454,696 minutes a day. From these results, the company has a working time of 7 hours or 420 minutes so that the warehouse feeder has a standard time that exceeds the predetermined working time. However, the standard time obtained from the warehouse leader and stock keeper for 7 normal working hours is that there are still unproductive activities due to the loading and unloading process which is hampered so that it is carried out during overtime, it occurs because of a lack of workers

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to assist the loading and unloading process so that the process is hampered.

Based on the workload calculation, the workload for the warehouse leader is 89% with a productive percentage value of 74%, the stock keeper has a workload of 93% with a productive percentage value of 77.9%, and the warehouse feeder has a workload of 102. % with a productive percentage of 84.4% Normal workload has a percentage value of 100% if it is above 100% then it has a high workload, it can be seen that the percentage of workload from warehouse feeder has a high workload of 102%.

So it is necessary to calculate the number of workers needed so that the workload of the warehouse feeder is ideal.

The calculation of the number of workers to the warehouse feeder is carried out using the warehouse feeder workload percentage. After calculating the number of workers, the results of the workload when added to 2 warehouse feeder workers are 51% and it is said that the ideal does not exceed 100%. For the decision to increase the number of workers related to a decrease in workload because of the percentage of productive, standard time, and also the workload that exceeds the company's stipulations and also the ideal limit for the percentage of workload. So that a helper is added to help in the spare

parts and raw material warehouse for the loading and unloading process and delivery of goods from the addition of packaging. so that the productivity and workload of the warehouse leader, stock keeper, and warehouse feeder for 7 working hours will be more optimal. In addition, increasing the workload for the warehouse leader so that the workload increases from 89% due to the large number of productive activities but not in accordance with the job description, so it is necessary to add additional tasks to the job description to assist in the loading and unloading process and delivery of goods so that the productive percentage and workload increase to 96%.

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Tabel 6. Job Description Warehouse Feeder (with the addition of worker)

No	Position	Code	Work Elements	
1.	*Warehose Feeder* 1	B1	Move spare parts from the truck into the warehouse	Transportasi
		B2	Moving raw materials from trucks into the warehouse	Transportasi
		B3	Send spare parts and raw materials to the blending department	Transportasi
		B4	Move pallets from the warehouse to make it easier to use in the arrangement and arrangement of goods	Transportasi
		B5	Organizing and arranging goods in the warehouse so that they are organized, neatly arranged, and safe	Transportasi
		B6	Transferring material goods to the blending process	Transportasi
		B7	Send goods that have been arranged on pallets from the spare parts and raw material warehouse area to the parts that are needed	Trasnportasi
		B8	Checking the condition of the forklift before and after checking it is operated when any damage can be detected and repaired immediately	Inspeksi
		B9	Clean the forklift after operation so that it is always clean	Maintenance
2.	*Warehouse Feeder* 2	D1	Move packaged goods from trucks into the warehouse	Transportasi
		D2	Send packaging to the packaging warehouse	Transportasi
		D3	Move pallets from the warehouse to make it easier to use in the arrangement and arrangement of goods	Transportasi
		D4	Organizing and arranging goods in the warehouse so that they are organized and neat and also safe	Transportasi
		D5	Move packaging from warehouse to be used in the shipping process	Transportasi
		D6	Deliver goods that have been arranged on pallets from the warehouse area to parts that are needed	Trasnportasi
		D7	Checking the condition of the forklift before and after checking it is operated when any damage can be detected and repaired immediately	Trasnportasi

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