Determination the Number of Packing Operators Using Work Sampling Method

Yani Iriani[l], Lili Ramli [2]

[1,2]Industrial Engineering Department Faculty of Engineering Widyatama University Bandung, Indonesia
yani.iriani@widyatama.ac.id[1] ,lili.ramli@widyatama.ac.id

Article History: Received: 10 January 2021; Revised: 12 February 2021; Accepted: 27 March 2021; Published online: 20 April 2021

Abstrct:PT. X is a manufacturing company in Indonesia that produces building materials such as Autoclave Aerated Concrete (AAC) lightweight concrete bricks, wall panels and floor panels. In the production process, this company is still experiencing several obstacles, one of which is in achieving the number of production targets at the Dept. Packing. Based on company data in the 2018 period the achievement of production targets at the Dept. Packing only reached 50.20% of the target requested by the company. One of the causes of not achieving the production target is the number of workers who are not balanced with the workload, which eventually causes a queue to build up at the Dept. Packing. The buildup that occurred at the Dept. This packing hinders the processes that were in the previous process section so that the production process does not run smoothly. To improve this situation, it is proposed to take work measurements using the Work Sampling method. This study aims to determine the standard time and the number of operators required. Work Sampling is a technique for making a large number of observations on the work activity of an operator for a randomly taken interval of time to one or more operators in a working or unemployed state. From the results of data processing, the standard time for operator A is 0.25 minutes, the standard time for operator B is 0.28 minutes, and the standard time for the operator is 0.25 minutes. Based on the standard time, the current operator capacity can only work 1,890 concrete bricks per day out of the 3,780 concrete bricks targeted by the company. Proposed comparison by adding the number of operators in each packing process from 3 operators to 6 operators. With this proposal, it can balance the workload of operators and increase the number of production targets demanded by the company, from 50.20% to 77.55%.

Keywords- Work Sampling, Standard Time, Workload

1. Introduction

PT. X is a company that produces building materials such as lightweight concrete bricks, floor panels, wall panels, dry mortar and lintels. Currently, the number of employees in this company is approximately 300 operators. PT. X is part of the trusted BETON WORKS Group. PT. X is here to be the number one solution for the need for quality lightweight concrete elements in Indonesia.

In the production process, PT. X There are still several problems that must be faced, one of which is the failure to achieve the production target of lightweight concrete bricks that occurred in the 2018 period. PT. This X has a production target of 1,039,500 pcs of concrete bricks in one year. In fact, the achievement figures obtained in that period were only 521,962 pcs of concrete bricks. That means only 50.20%

According to Mangkuprawira (2003), the factors that cause production targets are not achieved include human, material, machine, and environmental factors. The human factor is very dominant, namely 60%, the other factors are 40% of the material, machines, and the environment. The number of workers is not balanced with the existing load so that the production target is not achieved and results in an accumulation of goods. Dept. Packing is the most critical part, so that the queue that occurs can spread to the previous process (casting, cutting, tilling, etc.) which ultimately achieves production is not optimal.

Factors that influence the accumulation in the Dept. One of the packings is how the operator works, in this case the time used by each operator to work. PT. BEP itself does not know the standard time (standard time) required by the operator packing. Measuring working time is an attempt to complete the length of work required for a trained operator to complete a job (Sutalaksana, 2012). One way to measure working time is by using Work Sampling. The method Work Sampling is an approach method that can be used to measure productivity easily. Work Sampling can also be used to determine the productive and unproductive activities of an operator (Wignjosoebroto, 2008; Do, 2019).

2. Literature review

2.1. Work Measurement

Measurement is a method of determining the balance between human activities contributed and unit of output the resulting. This work measurement is related to efforts to determine the standard time required to complete a job. This standard time is the time needed by an operator who has an average level of ability to complete the job. This case includes the leeway given by taking into account the situation and conditions of the work that must be completed. Thus the standard time generated in this work measurement activity can be used as a tool to make work scheduling plans which state how long an activity must be carried out and how much output is produced and how much labor is needed to complete the work (Wignjosoebroto, 2008).

2.2. Stopwatch Time Study

According to Ramadan (2008), the measurement of work with stop hours (Stopwatch Time Study) was first introduced by Federick W. Taylor around the 19th century. This method is good to be applied to jobs that are short and repetitive. From the results of this measurement, it will be obtained the standard time to complete a work cycle will later be used as the standard time to complete a job for all workers who will complete the same job. Measuring work with downtime is an objective work measurement method because here the time is determined according to the facts that occur and not only subjectively estimated.

2.3. Work Sampling

Work Sampling is a technique for making a large number of observations of the work activities of machines, processes and operators. This work measurement is classified as direct work measurement because measurement activities must be carried out directly at the workplace to be studied. The difference with the stop clock method is that in this work sampling method the researcher is not constantly in the workplace but observes at random predetermined times. This technique of work sampling was first used by an English scholar named LHC Tippet in conducting his research in the textile industry. The method was Work Sampling developed based on the law of probability, therefore observing objects do not need to be carried out thoroughly but by using sample random (Iftikar Z, 2012).

2.4. Determine the Number of Sampling

Amount of Sampling number of samples that make observations with Work Sampling is generally determined by the researcher but usually not less than 30 times. Where all work carried out by operators is called productive and non-productive activities (Supranto, 2005).

2.5. Determine Observation at Random Time

According to Johanes (2005), in this step the researcher made observations on several work activities for an interval of time that was taken randomly. For this, usually one working day is divided into units of time whose amount is determined by the researcher with the following equation formula:

$$\frac{Work\ time\ X\ 60\ Minute}{\Delta t} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots. (2.1)$$

Based on the randomized time, observations are made by grouping work activities and idle activities. In this case, the definition of work and unemployment itself must be determined in advance. Then the work and unemployment activities are recorded and the percentage is determined.

2.6. Rating Factor and Allowance

According to Rachman (2013), in carrying out work measurements it is necessary to evaluate the operator's work speed during the measurement. The activity for evaluating this operator is called Rating Performance. Of the several existing rating systems, the Westinghouse Rating System is a system that is considered the most complete of the other rating systems. In addition to the skills and efforts that have been started by the existing rating system, Westinghouse adds more to the conditions and consistency of the operators in doing their work. The table rating factor can be seen in Table 2.1 below :

The normal time for a job is to show that an operator who has average ability will finish his job at a normal working speed. The determination of allowances is needed to anticipate the time when an operator is not in a working condition (Rachman, 2013). The table for determining allowances can be seen in Table 2.2 below:

Table 2.1 *Westinghouse System Rating*

Faktor	Kelas	Lambang	Nilai	Faktor	Kelas	Lambang	Nilai
Skill	*Superskill*	A1	+0,15	*Conditions*	*Ideal*	A	+0,06
		A2	+0,13				
	Excellent	B1	+0,11		*Excellently*	B	+0,04
		B2	+0,08				
	Good	C1	+0,06		*Good*	C	+0,02
		C2	+0,03				
	Average	D	+0,00		*Average*	D	+0,00
	Fair	E1	-0,05		*Fair*	E	-0,03
		E2	-0,10				
	Poor	F1	-0,16		*Poor*	F	-0,07
		F2	-0,22				
Effort	*Superskill*	A1	+0,13	*Consistency*	Perfect	A	+0,04
		A2	+0,12				
	Excellent	B1	+0,10		*Excellent*	B	+0,03
		B2	+0,08				
	Good	C1	+0,05		*Good*	C	+0,01
		C2	+0,02				
	Average	D	+0,00		*Average*	D	+0,00
	Fair	E1	-0,04		*Fair*	E	-0,02
		E2	-0,08				
	Poor	F1	-0,12		*Poor*	F	-0,04
		F2	-0,17				

Table 2.2 *Allowance*

FACTOR	ACTIVITY	ALLOWANCE (%)		
A. ENERGY EXPENDED		LOAD	MAN	WOMAN
1. Can be ignored	Work at the table, sit	Without load	0.0 - 6.0	0.0 - 6.0
2. Very light	Work at the table, stand	0.00 - 2.25 kg	6.0 - 7.5	6.0 - 7.5
3. Light	Shovel, light	2.25 - 9.00 kg	7.5 - 12.0	7.5 - 16.0
4. Moderate	Hoe	9.00 - 18.00 kg	12.0 - 19.0	16.0 - 30.0
5. Heavy	Swinging a heavy hammer	19.00 - 27 kg	19.0 - 30.0	
6. Very heavy	Shouldered the burden	27.00 - 50.00 kg	30.0 - 50.0	
7. Extraordinary heavy	Shouldered the heavy sacks	Above 50kg		
B. WORK ATTITUDE				
1. Sit	Work sitting, light	0.0 - 1.0		
2. Standing on two legs	Upright body, supported by two feet	0.0 - 1.0		
3. Standing on one leg	One foot working on the control device	1.0 - 2.5		
4. Lie	On the side, back or front of the body	2.5 - 4.0		
5. Bend	Body bent, resting on two legs	4.0 - 10.0		
C. WORK MOVEMENT				
1. Normal	Free swing from the shoulder	0		
2. Limited	Limited swing from the shulder	0 - 5		
3. Difficult	Carrying heavy loads with one hand	0 - 5		
4. In limited limbs	Work with one hand	5 - 10		
5. All limbs are limited	Working in the narrow mining passageway	10 - 15		
D. EYE FATIGUE			GOOD	BAD
1. The gaze falters	Bring measuring instrument	LIGHTING	0.0 - 6.0	0.0 - 6.0
2. An almost continues views	Meticulous jobs		6.0 -7.5	6.0 -7.5
3. A continous view with an arbitary focus	Check for defect in the fabric		7.5 - 12.0	7.5 - 12.0
4. Continous view with fixed focus	Very thorough eximination		19.0 - 30.0	19.0 - 30.0
E. WORKPLACE TEMPERATURE			NORMAL	OVER
1. Frozen	Under 0	HUMIDITY	Above 10	Above 12
2. Low	0 - 13		10 - 5	12 - 5
3. Moderate	13 - 22		5 - 0	8 - 0
4. Normal	22 - 28		0 - 5	0 - 8
5. High	28 - 38		5 - 40	8 - 100
6. Very high	Above 38		Above 40	Above 100
F. ATMOSPHERIC STATE				
1. Good	Ventilated room are good, fresh air	0		
2. Enough	Ventilation is not good, there are smells	0 - 5		
3. Not good	Presence of toxic / non-toxic dust	5 - 10		
4. Bad	Must use inhaler	10 - 20		
G. GOOD ENVIROMENTAL CONDITION				
1. Clean, healthy, bright, with low noisy		0		
2. Duty cycle repeatedly between 5-10 seconds		0 - 1		
3. Duty cycle repeatedly between 0-5 seconds		1 - 3		
4. Very noisy		0 - 5		
5. If the influencing factor decreas the quality		0 - 5		
6. Felt a vibration on the floor		5 - 10		
7. Extraordinary circumtances (noisy, etc.)		5 - 10		
H. PERSONAL ALLOWANCE			MAN	WOMAN
1. Eliminate thirst			2 - 2.5 %	5%
2. Go to Toilet				
3. Talk with friend				

2.7. Uniformity Test

According to Wignjosoebroto (2008), data uniformity testing is a test that is useful for ensuring that the data collected comes from the same system. Through this test, we can detect differences and data which out of control we can draw the control map. To create a control map we determine the control limits using the following equation:

a. Productivity

$$\frac{\textit{Number of Observations - Non-Productive Activities}}{\textit{Number of Observations}} X100\% \quad (2.2)$$

b. Upper Control Limit (UCL)

$$UCL = \bar{p} + k\sqrt{\frac{\bar{p}\,(1-\bar{p})}{n}} \qquad (2.3)$$

c. Lower Control Limit (LCL)

$$BKB = \bar{p} - k\sqrt{\frac{\bar{p}\,(1-\bar{p})}{n}} \qquad (2.4)$$

2.8. Adequacy Test

Adequacy test is a process to determine whether the data from the observations that have been made are sufficient or not. Observation data is said to be sufficient if N> N ', namely the number of observations made is greater than the number of observations required. To get the number of observations that must be made, you can find the following equation formula:

$$N' = \frac{k^2(1-p)}{S^2 p} \qquad (2.5)$$

2.9. **Determination of Level of Accuracy**

According to Purnomo H (2003), after all observations are made there is one more calculation to determine whether the results of these observations can be categorized as sufficiently accurate or not. To find out this can be done with the following equation formula:

$$S = \left[\frac{k\sqrt{\frac{\bar{p}\,(1-\bar{p})}{N}}}{\bar{p}} \right] \qquad (2.6)$$

2.10. **Determination of Standard Time**

According to Sutalaksana (2006), if the measurements have been completed, the next step is to calculate the standard time from the data. To calculate standard time, you can find the following equation formula:

$$\frac{TT\ x\ WT\ x\ RF}{\sum Yi}\, x\, \frac{100\%}{100-Allowance} \qquad (2.7)$$

2.11. **Calculation of Operator Needs Based on Standard Time**

According to Groover (2001), the standard time is very helpful in determining *manpower planning*. This standard time is the time needed by an operator who has an average level of ability to complete a job. If the standard time is known and the data is stated to be uniform and sufficient, then calculate the productive working hours and the total time for product processing to determine the number of standard operator requirements.

a. Productive Hours of Work

Total Working Hours X Number of Observations (2.8)

b. Total Time

$$WT = Wb\ X\ Yi \qquad (2.9)$$

c. Needs of Standard Operators

$$JTK = \frac{Wt}{JKP} \qquad (2.10)$$

2. Data Processing

2.6. **Calculating Operator Productivity**

Percentage of productivity can be found using the formula equation (2.2) below:

$$\frac{Number\ of\ Observations\ -\ Non\ Productive\ Activities}{Number\ of\ Observations}\ x\ 100\%$$

From the observations, the percentage of productivity of each operator is obtained as follows:

Table 3.1 Percentage of Operator Productivity A

Observation to	Operator Activity A		Amount	%
	Productive	Non Productive		
1	64	6	70	0,91
2	62	8	70	0,89
3	65	5	70	0,93
Average				0,91

Table 3.2 Percentage of Operator Productivity B

Observation to	Operator Activity B		Amount	%
	Productive	Non Productive		
1	64	6	70	0,91
2	62	5	70	0,93
3	65	6	70	0,91
Average				0,92

Table 3.3 Percentage of Operator Productivity C

Observation to	Operator Activity C		Amount	%
	Productive	Non Productive		
1	62	8	70	0,89
2	64	6	70	0,91
3	62	8	70	0,89
Average				0,90

2.7. **Data Uniformity**

Data uniformity test was conducted at a 95% confidence level and 5% accuracy level. To test the uniformity of this data, it can be tested using the equations (2.3), (2.4) as follows:

$$UCL = \bar{p} + k\sqrt{\frac{\bar{p}\,(1-\bar{p})}{n}}$$

$$LCL = \bar{p} - k\sqrt{\frac{\bar{p}\,(1-\bar{p})}{n}}$$

An example of data uniformity test calculation for operator A is as follows:
For operator A with $\bar{p}$ = 0,91

$$\text{UCL} = 0{,}91+2\sqrt{\frac{0{,}91\,(1\text{-}0{,}91)}{70}} = 0{,}98$$

$$\text{LCL} = 0{,}91\text{-}2\sqrt{\frac{0{,}91\,(1\text{-}0{,}91)}{70}} = 0{,}84$$

Using the data above, a uniformity test control map is made for operator A as shown in Figure 3.1 below.

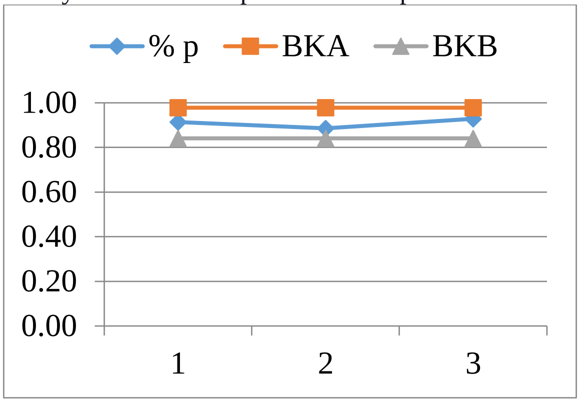

Figure 3.1 Control Map of Operator Average Productivity A

The productivity control limit for each operator can be seen in Table 3.1 as follows:

Table 3.4 UCL & LCL for each Operator

Operator	N	% p	BKA	BKB
A	70	0,91	0,98	0,84
B	70	0,92	0,98	0,85
C	70	0,90	0,97	0,82

2.8. **Data Adequacy**

Uniformity test was carried out at a 95% confidence level and 5% accuracy level. Where if N '<N then the data is sufficient and the observation is stopped. To test the adequacy of this data, it can be tested using the equation formula (2.5) as follows:

$$N' = \frac{k^2(1\text{-}p)}{S^2 p}$$

Example of data sufficiency test calculation on operator A as follows:
For operator A with $\bar{p}$ = 0,91

$$N' = \frac{(2)^2(1\text{-}0{,}91)}{(0{,}05)^2\,0{,}91} = 159{,}16$$

Because N' <N (159.16 <210) then the data is sufficient.
The data sufficiency test for each operator can be seen in Table 3.2 as follows:

Table 3.5 Adequacy Test for each operator

Operator	N	N'	%	Information
A	210	159,16	0,91	Enough
B	210	140,93	0,92	Enough
C	210	187,23	0,90	Enough

2.9. **Calculating the Level of Accuracy of Data**

Calculation of this data is carried out at a 95% level of confidence and an accuracy level of 5%. To find the level of accuracy, you can find the equation (2.6) as follows:

$$S = \left[\frac{k\sqrt{\frac{\bar{p}\,(1-\bar{p})}{N}}}{\bar{p}}\right]$$

Example of calculating the level of data accuracy as follows:

$$\bar{p} = \frac{pA+pB+pC}{3} = \frac{0{,}91+0{,}92+0{,}90}{3} = 0{,}91$$

$$S = \left[\frac{k\sqrt{\frac{\bar{p}\,(1-\bar{p})}{N}}}{\bar{p}}\right] = \left[\frac{2\sqrt{\frac{0{,}91\,(1-0{,}91)}{210}}}{0{,}91}\right] = \frac{0{,}03990}{0{,}91} = 0{,}044$$

From the calculation results above, the price of S ± 4.4% is less than 5% (degree of accuracy desired) then the number of 210 random observations that have been made has met the desired accuracy requirements.

2.10. **Calculating Standard Time**

The resulting standard time calculation will be used in determining the number of operator requirements. To calculate this standard time using the equation (2.7) as follows:

$$\frac{TT \; x \; WT \; x \; RF}{\sum Yi} x \frac{100\%}{100-Allowance}$$

An example of calculating the standard time for operator A is as follows:

$$\frac{(3 \text{ x } 7 \text{ x } 60) \text{ X } (0{,}91) \text{ X } (1+0{,}02)}{5670} \text{ x } \frac{100}{100-19} = 0{,}2547 \text{ minutes}$$

Total time for operators A, B, and C in carrying out the process *packing* is:

Ws Total = 0,25 + 0,28 + 0,25 = 0,78 minutes.

2.11. **Calculating the Number of Optimal Operators Needs**

Calculating the number of operator needs to know the total time needed to work on lightweight concrete brick products. To calculate the total time, it can be done with the equations (2.8), (2.9), and (2.10) as follows:

a. Productive Working Hours

Total Working Time X Number of Observation

b. Total Time (Wt)

$WT = Wb \; X \; Yi$

c. Standard Operator Requirements (KOS)

$$KOS = \frac{Wt}{JKP}$$

Demand for production targets for the 2019 period for lightweight concrete brick products at PT.BEP can be seen in Table 3.3 as follows

Table 3.6 Production Targets for the 2019 Period

Periode	Production Target (Pcs)	Working Days	Periode	Production Target	Working Days
January	98280	26	July	98280	26
February	90720	24	August	102060	27
March	98280	26	September	94500	25
April	98280	26	October	102060	27
May	86940	23	November	98280	26
June	88040	18	December	90720	24
The Average Production Target				93870	
Average number of days worked				24,83	

Based on Table 3.3, it can be calculated the number of standard operators that must be employed in the *Dep. Packing* at PT.BEP.

1. Operator A

Productive activity for Operator A is to pull the concrete bricks out of the machine *autoclave*, move the concrete bricks to the temporary area using *hoist* 1, and move the concrete bricks from the temporary area to the area *packing* using the *hoist* 2.

Total production target requests : 93870 pcs / month
Standard time : 0.25
Wt = Ws x Yi : 0,25 minutes x 93870
: 23.467,5 minutes
JKP = Total waktu kerja x 60 minutes : 24,83 x 7 x 60
: 10430 minutes
KOS = Wt / JKP : 23.467,5 / 10430
: 2,25 people

2. Operator B

The productive activity of Operator B is to check the condition of the concrete bricks, ensure that the concrete bricks are separated from each row and column, and arrange the concrete bricks onto pallets according to the *grade* .

Number of production target requests : 93870 pcs / month

Standard time : 0.28 minutes
Wt = Ws x Yi : 0,28 minutes x 93870
: 26.283,6 minutes
JKP = Total waktu kerja x 60 minutes : 24,83 x 7 x 60
: 10430 minutes
KOS = Wt / JKP : 26.283,6 / 10430
: 2,52 people

3. Operator C

The productive activity of Operator C is neatly tying the concrete bricks that have been stacked on pallets, tying them from all sides and preparing empty pallets.

Number of production target requests : 93870 pcs / month
Standard time : 0.25 minutes
Wt = Ws x Yi : 0.25 minutes x 93870 :
: 23,467.5 minutes
JKP = Total working time x 60 minutes : 24,83 x 7 x 60
: 10430 minutes
KOS = Wt / JKP : 23.467,5 / 10430
: 2,25 people

3. Analysis

2.12. Analysis of Production Target Achievement

Score milestones production targets *Dept. Packing* at PT.BEP for the January-December 2018 period can be seen in Figure 4.1 as follows:

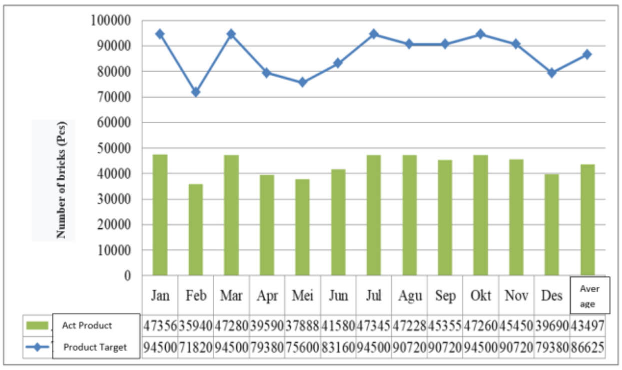

Figure 4.1 Graph Achievement of Production Targets for the 2018 Period

Based on Figure 4.1 it can be seen that the achievement of the total production targets at the *Dept. Packing is* below the target number, the percentage of production is only 50.20%. The number of production targets for the *Dept. The packing* daily 3,780 concrete bricks. There are currently 3 operators and in fact, they can only complete 1,890 concrete bricks in one working day. This is proven by the fact that the work achievement of the three existing operators resulted in not achieving the required production target.

The results of the observations that have been made show that the standard time required by the work operator to do their work is 0.25 minutes for operator A, 0.28 minutes for operator B, and 0.25 minutes for operator C. used in determining the optimal number of operators required to be employed in the *Dept. Packing*.

2.13. Optimal Operator Needs Analysis

The number of operators in the *Dept. Packing* currently consists of 3 operators. With the existing operators, the achievements in the January-June 2019 period can be seen in Table 4.1. Based on the results of calculations carried out on operators at the *Dept. packing* This can be calculated the number of operators needed to complete this packing job is 6 operators. With the addition of the number of operators, it can be seen the comparison of achievements in the July-December 2019 period in Table 4.2.

Table 4.1 Data *Exiting* for 2019

2019				
Periode	Production Target (Pcs)	Working Days	Actual Production Achievements	%
January	98280	26	49140	50,00
February	90720	24	45360	50,00
March	98280	26	47250	48,08
April	98280	26	47250	48,08
May	86940	23	43470	50,00
June	88040	18	34020	38,64
Average	93423,33	23,50	44415	47,47

Table 4.2 Proposed Comparison for the 2019 Period

2019				
Periode	Production Target (Pcs)	Working Days	Production Achievement Comparison	%
July	98280	20	75600	76,92
August	102060	20	75600	74,07
September	94500	20	75600	80,00
October	102060	20	75600	74,07
November	98280	20	75600	76,92
December	90720	20	75600	83,33
Average	97650	20,00	75600	77,55

This evaluation is carried out to compare the results of data processing that have been carried out with the facts obtained in the field. The results of data processing with a standard time of *packing* lightweight concrete bricks, the number of operators needed to complete the work is obtained. The details of the need for the number of operators are 2.25 people for operator activities in section A, 2.52 people for operator activities in section B, and 2.25 people for operator activities in section C. Based on Tables 4.1 and 4.2 can be seen the comparison of numbers achievement of production targets for the January-June 2019 period with the July-December 2019 period. By adding operators in the *Dept. packing* This from 3 operators to 6 operators can increase the percentage of achieving the production target number from 50.20% to 77.55%.

4. Conclusion and Suggestion

2.6. Conclusion

Based on the results of the research that has been done, several things can be concluded as follows:

1. The results of the calculation of standard time (standard time) that have been carried out to evaluate the results of operator productivity in the dept. packing at this time, the results show that the standard time for operator A is 0.25 minutes in one time moving concrete bricks from the temporary area to the area packing, the standard time for operator B is 0.28 minutes in one time moving one concrete brick to the pallet, and the time the standard for operator C is 0.25 minutes at a time considering a pallet containing lightweight concrete bricks. Based on the standard time, the current operator capacity can only work 1,890 concrete bricks per day out of the 3,780 concrete bricks targeted by the company. This means that with the actual working time currently only fulfilling 50.20% of the target, it can be said that the performance of the existing operators is less than optimal in carrying out their work.
2. The ratio between the number of operators that exist today is 3 people producing 1,890 concrete bricks per day. The comparison using the Work Sampling method is to add the number of operators in each section to 6 operators by producing 3,780 concrete bricks per day. With the addition of these operators, it can increase the number of percentage figures for achieving the production target from 50.20% to 77.55% which can compensate for the number of production targets demanded by the company and of course can reduce the occurrence of queuing activities that hinder other production processes.

2.14. **Suggestion**

This following are suggestions that can be given to companies at PT. Persada Element Concrete (BEP) based on the results of research conducted, including:

1. For companies, seeing conditions like this is very necessary to add operators in the *Dept. Packing*. The addition of these operators will greatly assist in increasing the achievement of production targets as well as in balancing the workload of the operators
2. Additional operators that can be done by the company can use several alternative options, such as the following:

a. Add operators in all parts of the process from A to C, and divide the working hours into *shifting.*

b. Adding operators only in process B, without adding operators in process A and C and working hours remain *non-shift.*

c. Adding operators in all parts of the process from A to C, dividing working hours into *shifting* and adding machines and re-*layout packing areas.*

3. For further researchers, the observations made by the author still have shortcomings, namely in calculating the percentage of the workload of each operator. The next researcher might be able to add the method *Workload Analysis* to find out the workload of each operator to make it easier to get the operator's needs needed.

Reference

1. Arikunto, Suharsimi Dr. (2000). *Prosedur Penelitian Suatu Pendekatan Praktek (Edisi Revisi III).* Yogyakarta: Penerbit Rineka.
2. DO NASCIMENTO, M. A. G. (2019). Institutional Scholarship Program for Initiation in Teaching (PIBID) Geography: Reviewing the Relationship between School and University. Review of International Geographical Education Online, 9(3), 604-617.
3. Groover, Mikell P. (2001). *Automation, Production Systems, and Computer-Integrated Manufacturing (2nd Edition).* New Jersey: Prentice-Hall, Inc.
4. Mangkuprawira, S. (2003). *Manajemen Sumber Daya Manusia Strategik*. Jakarta: PT. Ghalia Indonesia.
5. Purnomo, H. (2003). *Pengantar Teknik Industri*. Yogyakarta: Graha Ilmu.
6. Rachman, Taufiqur. (2013). Penggunaan Metode Work Sampling untuk Menghitung Waktu Baku dan Kapasitas Produksi Karungan Soap Chip di PT. SA. *Jurnal Teknik Industri Universitas Esa Unggul*. 9(1), 49-60.
7. Ramadhan, Rahadian., Tama, Ishardita P., & Yanuar, Remba. (2008). Analisa Beban Kerja dengan Menggunakan Work Sampling dan Nasa-Tlx untuk Menentukan Jumlah Operator (Studi Kasus: PT XYZ). *Teknik Industri, Universitas Brawijaya.* 5(2), 964-972.
8. Rinawati, D Ika., Puspitasari, D., & Muljadi, F. (2012). Penentuan Waktu Standar dan Jumlah Tenaga Kerja Optimal Pada Produksi Batik Cap (Studi Kasus: IKM Batik Saud Effendy, Laweyan. *Jurnal Teknik Industri Universitas Diponegoro*. 7(3), 143-150.
9. Supranto, Johannes. (2005). *Sampling Untuk Pemeriksaan (Edisi 2).* Jakarta: Penerbit Universitas Indonesia (UI-Press).
10. Sutalaksana, Iftikar Z, Anggawisastra, R & Tjakraatmadja, J.H. (2012). *Teknik Perancangan Sistem Kerja (Edisi 2).* Bandung: ITB Bandung.
11. Sutalaksana, Iftikar, dkk. (1999). *Tata Cara Kerja*. Bandung: Departemen Teknik Industri ITB.
12. Wignjosoebroto, Sritomo. (2008). *Ergonomi Studi Gerak dan Waktu*. Surabaya: Guna Widya.