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Analysis of Work Measurement Using the Stopwatch Time Study Method at PTEA

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ABSTRACT

In the era of globalization or the world of free trade, competition in the industrial world is increasing rapidly, this causes business competition to increase. Seeing the importance of measuring every activity carried out by the company, an accurate measurement method is needed to be able to provide accurate information on the time needed and the efficiency of each product activity in meeting production targets to achieve profits. The Stopwatch Time Study method is a work measurement technique using a stopwatch as a means of measuring the time shown in the completion of an observed activity. From the measurement results, a standard time will be obtained to complete a work cycle, where this time will be used as a standard for completing work for all workers who will carry out the same work as that. To determine the standard time, first calculate the cycle time and the time normal considering the degree of adjustment and allowance. Based on the results of data processing and discussion, it can be concluded that the lowest normal time is for employee 2 with a time of 39.05 seconds. Employee adjustment factor 2 with a total adjustment of +0.12 and employee allowance factor 2 with a total allowance of 22.

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INTRODUCTION

In the era of globalization or world trade, the freedom of competition in the world industry is increasing rapidly, this causes business competition to increase. This situation is increasingly becoming a risky threat for every company that participates in it, special methods and skills are needed so that companies can survive and win the competition. Production is an effort or activity to add value to an item. The direction of activity is aimed at regulatory efforts that can add to or create the use of an item or service [1].

The production process that is carried out efficiently and effectively is one of the goals that many companies achieve, in carrying out this goal it is inseparable from the activities of managing factors of production through the equipment owned into products in the form of goods and services. Seeing the importance of measuring every activity carried out by the company, an accurate measurement method is needed to be able to provide accurate information on the time needed and the efficiency of the movement of each activity to produce products in meeting production targets to achieve maximum profit. One of the most widely used methods by a company in measuring time is time study, which is an effort to determine the length of work needed by an operator to complete a specific job at a normal work speed level in the best work environment at that time [2].

Time Studies are carried out using a stop clock tool to observe task times. The standard time for a task is calculated based on observing a worker carrying out his cycle of tasks repeatedly. Once set, standard time applies to all other workers performing similar work. Selected workers are workers who understand correctly. The amount of time that must be used to carry out certain activities under normal working conditions is called the standard of work. In order to be able to compare the best work time from the existing work methods, a standard time or standard time is needed as a reference for determining the best work method [3].

Productivity levels that are less than optimal can affect timeliness in the production process. Companies that do not yet have a standard working time for workers will have an impact on production process habits, starting from the amount of time wasted working and employees who work slowly and not agile can affect the time and speed of workers in completing work. Fast working speed will be beneficial for the production process in achieving production targets, while employees who have changing work speeds will be a slight disadvantage for the business unit because they are unable to achieve targets. So, to meet the demand from consumers will be required. Measurements will be carried out using a Stopwatch Time Study and will be carried out repeatedly with the aim of knowing the ability of workers, the level of worker productivity, the level of sustainability of workers in completing their work [3,4].

Measuring working time at the same time from the time of preparation until the end of the work will be completed is something that cannot be justified. Generally, in carrying out measurements it becomes work elements. The division of operations into work elements is for the following reasons [5]:

1. Dividing work elements in detail and can be measured easily.
2. The amount of standard time can be determined based on existing work elements, by knowing the standard time with work elements which in this case is known as the standard time element for elements of a work operation.
3. Will be able to analyze the redundant time for each element.
4. An operator can also work at different tempos during each cycle.

Measurement is work that observes workers and records their work time, both in each element or cycle using the tools that have been prepared. If the operator is ready in front of the machine or in another workplace where the working time will be measured, the measurement has a position where he stands observing and taking notes. This position is such that the operator does not interfere with his movement and/or hesitate because he is being watched too much, and it also makes it easier for the measurer to lure the work so that he can follow both the moments of the cycle and the elements that start and end.

In general, the position slightly to the back of the operator as far as less than a meter is a good place. What is done is a preliminary measurement and the purpose of making preliminary measurements is to know how many measurements must be made for the desired level of accuracy and confidence. Preliminary measurement is carried out by taking a few measurements directed by those being measured, after the first stage of measurement is carried out, 3 stages must follow, namely we test the uniformity of the data, calculate the number of measurements needed and if it is not sufficient, proceed with the second stage, and continue with the third stage [1,3,6].

Taking this measurement is the actual time it takes to complete a job. Because the completion time is not known in advance, measurements must be made. The level of accuracy indicates a deviation of the maximum measurement results from the actual completion time. This we usually expressed in percent. Meanwhile, the level of confidence indicates the measurer's confidence that the results obtained meet the accuracy requirements earlier, even this is expressed in percent [7]. Work measurement is an attempt to find out how long it takes the operator to complete a job properly and in designing the best work system. The purpose of measurement of work to determine the methods of measuring work time. In addition, measuring work time aims to evaluate and optimize a job [6].

Working time used to determine the length of time needed by workers who meet the requirements, with a standard method and working at a standard work stage, to carry out a particular task. The science that studies the principles and techniques to get a good work system design. An activity to determine the time required for an operator who has average ability and is well trained in carrying out a work activity under normal working conditions and tempo [6,8].

The main objective of this activity is closely related to efforts to set a standard time. In its application, work measurement consists of human components, materials, machines, tools, and money [9,10]. Working time measurement techniques can be divided into two, namely:

1. Direct measurement of work time, i.e., measurement is carried out directly at the place where the work being measured is in progress:
   a. Stopwatch Time Study.
   b. Work Sampling (Work Sampling).
2. Indirect measurement of work time, measurements made without an observer must be in the place where the work being measured is in progress, but the observer must understand the work process being measured.
   a. Standard Time Data (Standard Data).
   b. Movement Time Data (Predetermined Time System)

The selection of this working time measurement must be adjusted to the current needs and conditions because each of these working time measurements has objectives and characteristics that must be understood. Choosing an inaccurate method can result in lost time, so additional measurements or repeated measurements with a more appropriate method are needed. Procedures that need to be considered in measuring time are as follows [11,12]:

a. Standardize work methods.
b. Choose workers who are relatively capable, so you don't have to give instructions to him so that the measurement runs smoothly.
c. Using a timekeeping device that meets the requirements (stopwatch), as well as stationery.
d. Inform the worker being measured about the purpose of the time measurement.
e. Start measuring by recording the time of the worker's standard movements.

Balancing worker activity on jobs that require several workers as well as setting supervision targets and providing a basis for measuring supervisory efficiency are the reasons for carrying out work measurements [6].

Work measurement can be used for a variety of different purposes which are often rooted in

controversies about work measurement techniques and standards. It is therefore the responsibility of the operations manager to define objectives and ensure that performance measurement techniques are used appropriately. Work measurement techniques can be used for the following purposes [6,11,13]:

1. Evaluate work performance. This is done by comparing the actual output over a period with the standard output determined from work measurements.
2. Planning for manpower requirements. For a given level of future output, labor measurements can be used to determine how much labor input is required.
3. Determine the available capacity. For a given level of manpower and equipment availability, work measurement standards can be used to project available capacity.
4. Determining the price or cost of a product. Labor standards, which are obtained through measurement of work, are an element of the costing or selling price system. This activity, in turn, depends on the measurement of work when cost is the basis for pricing.
5. Comparing work methods. When different methods for a job are being considered, work measurements can provide a basis for making economic comparisons of the methods. This is the essence of scientific management, namely designing the best method based on the precise study of time and movement.
6. Simplify the scheduling of operations. One of the data inputs for all scheduling systems is the estimated time for work activities. These estimates are derived from work measurements.
7. Establish wage incentives. With wage incentives, workers receive more wages for more output. Underlying this incentive program is a time standard that defines 100 percent output.

Measurement of working time is a measurement related to determining the length of time needed to carry out an activity or the activities of an operator in completing his work. The purpose of measuring working time is to obtain standard time. There are several time categories as follows [6,14]:

A. Observation time (Cycle Time)

   Cycle time is the time between completion of two successive meetings, assuming constant for all meetings. It can be said that the cycle time is the result of direct observation which is stated in the stopwatch. The time required to carry out work elements will generally vary slightly from cycle to work cycle even if the operator works at normal and uniform speed, each element in a different cycle cannot always be adjusted at the same time. This variation and time value can be caused by several things. One of them can occur due to differences in setting the start or end of a work element that should be read from the stopwatch [15,16].

B. Normal Time

   Normal time is working time that has considered the adjustment factor, namely the average cycle time multiplied by the adjustment factor. In the practice of measuring work, the method for applying operator work performance ratings is based on a single factor, namely operator speed, space or tempo. This system is known as “Performance Rating/speed Rating)”. Rating factors are generally applied to normalize working time which is obtained from work measurements due to the changing tempo or speed of the operator's work. The time it takes workers to complete an activity under normal working conditions. Normal time here does not include free time needed to unwind (fatigue) or the needs of a worker (personal needs). The time value obtained here still cannot be determined as the standard time for the completion of a work operation, because here the factors related to the Allowance Time so that the operator can work as well as possible are still not related [15,17].

C. Standard Time

Standard time is the time used by the operator to produce one unit of product type data. The standard time for each part must be stated including the tolerance for rest to overcome fatigue or for unavoidable factors. However, the period of use of the standard time has a limit. Standard time is the time needed by workers to complete a job. This Standard Time includes an allowance time, an allowance is an allowance given to remove fatigue and unavoidable obstacles, which is given by considering the situation and conditions that must be resolved. The formula calculates Standard time[17,18,19].

From the measurement results, a standard time will be obtained to complete a work cycle, which time will be used as a standard for completing work for all workers who will carry out the same work as that. In general, the steps for measuring working time with downtime are as follows [6,14,20]:

1. The definition of the work to be examined is to measure the time and inform the purpose and objectives of this measurement to the workers selected to be observed.
2. Record all information related to the completion of work.
3. Divide work operations into work elements in as much detail as possible but still within the limits of convenience for time measurement.
4. Observe, measure, and record the time needed by the operator to complete the work elements.
5. Define the number of duty cycles to be measured and recorded.
6. Set the rate of performance of the operator when carrying out work activities that are measured and timed. This rate of performance is set for each existing work element and is shown only for operator performance. For work elements that are fully carried out by the machine, the performance is considered normal (100%).

The steps for the downtime method consist of collecting working time data during packaging and then processing the observation data in the following way [15,19]:

1. Calculating the average of the subgroups obtained from the observational data.
2. Calculate the standard deviation.
3. Calculate the subgroup mean standard deviation.
4. Perform a data uniformity test using a control chart and then plot the data onto a graph, so that data that is outside the control limits can be identified.
5. Perform data adequacy test.
6. Perform normal time calculations.
7. Perform standard time calculations.

RESEARCH METHODS

The research method used in this research is a quantitative descriptive method. Descriptive method is a research method that seeks to describe phenomena that occur in a real, realistic, actual, real and at this time because of this research to make descriptions, pictures, or drawings in a systematic, factual, and accurate manner regarding facts, characteristics and relationships between phenomenon being investigated. Quantitative research methods emphasize objective phenomena and are studied quantitatively. Maximization of the objectivity of the research design was carried out using numbers, statistical processing, structures, and controlled experiments.

The data method used in this study were obtained from a variety of source obtained. Collection processes the data used is through the study field (field research), namely the method that used to obtain the data related to research, in a way establish direct contact with the field, i.e., by making direct observations on the working environment conditions company, then recorded for use get the required data in study.

This study uses a qualitative descriptive technique, which provides an overview of the object under study, namely analysis with the time study method for measuring work to determine the standard time

through the data and the time for each element of work, then the results will be drawn general conclusions. The stages determine the standard time with the following steps:

a. Determine and define the work to be observed (after a method analysis has been carried out).
b. Dividing the job into its proper elements (parts of work that often take no more than a few seconds).
c. Determine the number of times the observation will be carried out (the number of cycles or samples needed).
d. Time and record element times and performance levels.
e. Calculates the average observed (actual) time. The average observed cycle time is the arithmetic average of the measured times for each element, adjusted for unusual effects for each element.

RESULTS AND DISCUSSION

a. Receiving Raw Materials

Shrimp quality inspection by random sampling method, every 200 kg (8 baskets) for each supplier during unloading. Reject raw materials of poor quality. Unloading of raw materials is carried out in the receiving room. Shrimp unloaded from boxes/fiber brought by suppliers are transferred to baskets with a capacity of 25 KG.

b. Washing 1

Removes foreign matter from raw materials and inhibits bacterial growth. Use clean water and replace dirty water with clean water, check the water visually. Washing raw materials using running water by spraying raw materials in each basket containing shrimp.

c. Sorting

Size and sorting must be in accordance with product specifications. Sorting is done manually by separating the shrimp based on color, quality, and size. Shrimp that are not in accordance with the category are separated in the BS basket.

d. Weigh 1

Obtain the weight of the product according to specifications. Coding during weighing must match product identity. The product weight in the weighing process is 1.8KG and 0.9KG.

e. Washing 2

Removes foreign matter from raw materials and inhibits bacterial growth. Use clean water and replace dirty water with clean water. Check the water visually. Washing raw materials using running water by spraying raw materials in each basket containing shrimp.

f. Preparation

Get a product with an attractive appearance. How to arrange must look attractive. The method and total number of prawns per pan must comply with specifications.

g. Freezing

Obtain completely frozen product. The contact plate freezer must be allowed to cool before use.

Temperature checks are carried out every hour by QC officers (maximum temperature -20 degrees C). Refreeze if the product is not frozen. Products that have been frozen must be stored in cold storage while waiting for packaging (maximum temperature -20 degrees C).

h. Glazing
Prevent re-dehydration of shrimp during frozen storage by covering the shrimp with a layer of ice. Rinse the frozen shrimp in cold water or dip the frozen shrimp in cold water until all surfaces are covered with ice. Glazing should be according to specification as much as possible. Check the glazing visually.

To determine the standard time, the cycle time and normal time are first calculated by considering the level of adjustment and allowance.

Table 1. Time Measurement (Employee 1)

Sub-Group	Observation Priod (second)				
	1	2	3	4	5
1	47,81	33,40	38,37	36,61	22,47
2	35,60	27,01	40,13	29,97	37,92
3	50,01	20,74	37,25	31,42	35,78
4	37,80	23,94	35,41	33,28	40,18
5	31,56	28,93	37,42	33,27	33,81
6	33,08	39,40	41,10	28,37	35,50
7	27,28	45,11	39,27	35,49	28,30
8	37,61	27,42	38,92	23,97	48,13
9	35,55	38,05	38,11	37,31	29,10
10	32,12	40,31	42,81	35,59	25,58

Table 2. Time Measurement (Employee 2)

Sub-Group	Observation Priod (second)				
	1	2	3	4	5
1	11,87	8,08	15,10	9,58	10,18
2	10,48	17,24	16,24	13,42	8,37
3	16,68	15,14	15,33	10,18	14,38
4	10,42	22,28	17,49	15,71	13,64
5	19,03	18,97	15,91	13,46	10,92
6	18,32	11,32	10,14	15,10	9,27
7	17,17	14,10	17,22	10,19	13,45
8	10,78	11,18	13,24	8,23	15,39
9	23,05	10,13	12,38	11,75	18,47
10	14,00	12,22	13,75	13,46	12,59

Table 3. Time Measurement (Employee 3)

Sub-Group	Observation Priod (second)				
	1	2	3	4	5
1	180,24	180,18	240	180,2	120,58
2	180,11	180,17	180,42	180,41	180,1
3	120,46	180,16	180,55	180,37	180,22
4	180,14	180,2	180,28	180,4	180,05
5	180,16	180,05	180,41	120,58	180,12
6	180,16	180,15	180,19	180,17	180,05

7	180,37	180,19	180,1	180,25	180,17
8	180,56	120,59	180,25	180,29	180,2
9	240,03	180,1	120,57	180,4	180,27
10	180,16	180,08	180,08	180,38	180,17

Table 4. Calculation of Employee Time

	Cycle Time (seconds/pcs)	Normal Time	Standard Time (seconds/pcs)
Employee 1	34,87	39,05	48,23
Employee 2	13,74	15,39	18,76
Employee 3	176,65	197,85	243,36

Total Standard Time for 3 Components Work is to get things done work cycle on 900 gr Shrimp in a Pcs, the default time needed are: 310.35 seconds = 5.17 minutes / 900 gr.

CONCLUSION

In the industrial world, it is growing rapidly, this causes business competition to increase. Efforts to increase profitability and win the competition cannot be separated from the support of an important function in the company, namely the production function. Production is an effort or activity to add value to an item. Seeing the importance of measuring every activity carried out by the company, an accurate measurement method is needed to be able to provide accurate information on the time needed and the efficiency of the movement of each activity to produce products in meeting production targets to achieve maximum profit.

One of the most widely used methods by a company in measuring time is time study, which is an attempt to determine the length of work required by an operator to complete a specific job at a normal work rate in the best work environment at that time. Selected workers are workers who understand correctly. The amount of time that must be used to carry out certain activities under normal working conditions is called the standard of work. In order to be able to compare the best working time from the existing work methods, a standard time or standard time is needed as a reference for determining the best working method.

Based on the results of data processing and the discussion above, it can be concluded that the lowest normal time is for employee 2 with a time of 39.05 seconds. Employee adjustment factor 2 with total adjustment = +0.12 and employee allowance factor 2 with total allowance = 22. The calculation of working time is used as a guideline for companies to become a benchmark when scheduling production. the company can see every employee's ability and skill, standard time so that the production process can be efficient.

REFERENCES

[1] D. Putra. P., Jaenudin., and D. Taurusyanti. Penerapan Waktu Standar Pada Karyawan Dalam Rangka Mencapai Efektifitas Volume Produksi Pada Pt. Nina Venus Indonusa II. *Jurnal Online Mahasiswa (JOM)Bidang Manajemen*, vol. *3. no.*1, 2018, pp, 1-18.

[2] A. Kadim. Penerapan Manajemen Produksi & Operasi Di Industri Manufaktur.*2017*

[3] R. Afiani., and D. Pujotomo. Penentuan Waktu Baku dengan Metode Stopwatch Time Study

[4] Kasus CV. MANS Group. *Industrial Engineering Online Jounal, vol. 6, no.*1. 2017
[5] T. Bodroastuti. Faktor-Faktor Yang Mempengaruhi Produktivitas Kerja (Studi Pada Karyawan Bagian Produksi PT Mazuvo Indo). *Jurnal Kajian Akuntansi dan Bisnis*, vol. *1, no.* 1. 2017
[6] A. Firman, A. Analisis Pengukuran Kinerja Untuk Meningkatkan Produktivitas menggunakan Metode Time Study Danwork Sampling (Studi Kasus Pada PT Kebon Agung Malang). *Sinteks: Jurnal Teknik*, vol.8, no.1, 2019, pp. 30-35.
[7] Z. Faziati, N. Analisis Pengukuran Kerja Dalam Menentukan Waktu Standar Dengan Metode Studi Waktu Guna Meningkatkan Produktivitas Kerja Pada Shuttlecock PT. *Garuda Budiono Putra. Universitas Pancasakti Tegal.2019*
[8] A. Almaidah., A. Karyanto., K. Putra., and Wariori. R. Y. Laporan Praktikum Analisis Perancangan Kerja Penelitian Pengukuran Cara Kerja*. 2021*
[9] H. Notopramono. Analisis Beban Kerja dengan Metode Stopwatch Time Study Untuk Penentuan Jumlah Operator Optimal (Doctoral dissertation, Universitas Brawijaya). 2016
[10] H. Damayanthi., and S. Hidayat. Pengukuran Waktu Baku Stasiun Kerja Pada Pipa Jenis Sio Menggunakan Metode Jam Henti di PT. XYZ. In *Seminar dan Konferensi Nasional IDEC 2020*, pp. 1-9. 2 november 2020
[11] S. Reksohadiprodjo and H. Handoko. *Organisasi Perusahaaan.* Edisi 2. Yogyakarta. BPFE, 1999
[12] N. Sukma., F. Hidayat., and S. Anggarini,. G. Utomo, W. *Analisis perhitungan waktu baku dengan menggunakan metode jam henti pada produk pulley di CV. Putra mandiri jakarta*. *Jurnal PASTI, Vol. XII, no, 1*, 2013, pp. 119-136.
[13] A. Yuda, P., and F. Pulansari. Analisis pengukuran waktu kerja dengan stopwatch time study untuk meningkatkan target produksi di PT. XYZ. *JUMINTEN*, vol. *2, no.* 1, 2021, pp. 13-24.
[14] Rully, T., and Rahmawati, N. T. *Perencanaan Pengukuran Kerja Dalam Menentukan Waktu Standar Dengan Metode Time Study Guna Meningkatkan Produktivitas Kerja Pada Divisi Pompa Minyak Pt Bukaka Teknik Utama Tbk*. *Jimfe (Jurnal Ilmiah Manajemen Fakultas Ekonomi)*, Vol.1, no. 1, 2015, pp. 12-18.
[15] N. Yudisha. Perhitungan waktu baku menggunakan metode Jam Henti pada proses Bottling. *Jurnal Vorteks, vol. 2, no.2*, 2021, pp. 85-90.
[16] S. Novita., H, Arif., and A. Sakunda. Analisis Pengukuran Waktu Kerja Dengan Metode Pengukuran PT Japfa Comfeed Indonesia Tbk. *Skripsi. Universitas Bawijaya. Malang.2013.*
[17] Marathony, B.M. Pengukuran Waktu Baku Pada Proses Pembuatan Roda Gigi Di PT Taman Pratama, (Doctoral dissertation, http://unugha.ac.id). 2016
[18] Sucipto, A.N., Syamsuddin, S.R., Bagas, D.A,. and Tahoba, A. *Laporan Praktikum Analisa Perancangan Kerja*. Universitas Muhammadiyah Sorong. 2020
[19] Aryanto, Y.A. *Pengukuran Waktu Kerja Metode Jam Henti*. Retrieved Oktober, 19, 2022, from https://angga.staff.ipb.ac.id/?p=930 . 2018
[20] Rahma, M., and Pratama, A. J. Pengukuran Waktu Baku Stasiun Kerja Perakitan Komponen Pesawat Garuda Indonesia Temperature Control Valve (TCV) Menggunakan Metode Jam Henti Pada PT. GMF Aeroasia. *IENACO (Industrial Engineering National Conference)* 7 2019.
[21] Prayuda, S. B. Analisis Pengukuran Kerja Dalam Menentukan Waktu Baku Untuk Meningkatkan Produktivitas Kerja Pada Produksi Kerudung Menggunakan Metode Time Study Pada Ukm Lisna Collection Di Tasikmalaya. *Jurnal Mahasiswa Industri Galuh*, vol. 1 no. 01,2020, pp. 120-126.