



Work Analysis of Wire Handling Process Using Work Sampling Method and Standard Time Determination

Ayu Nurul Haryudiniarti^{1*}, Widya Putri²

^{1,2}Industrial Engineering, Faculty of Information and Science Engineering, Jakarta Global University, Indonesia, 16412

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ABSTRACT

Productivity is one of the main factors in the company where productivity will affect the production output. This research was conducted on the wire handling process and the method used was work sampling and standard time determination, where previously statistical calculations were carried out to see the uniformity of the data and also the adequacy of the data. The method used in this study is the work sampling method, where time data sampling is done using a table of random numbers. In addition, standard time calculations are also carried out. The results obtained are productive activities as many as 160 out of 200 observations or by 80% and non-productive activities by 40 out of 200 observations or by 20%. Statistical testing for data uniformity shows that the observation data from the first day to the fifth day are (1) 0.80 (2) 0.80 (3) 0.825 (4) 0.80 (5) 0.775 still within the upper control limit and the lower control limit, which are 1.1 respectively. and 0.5. Sampling of the work that has been done can be concluded that with a 95% confidence level the percentage of working time that can be used productively by workers is 80% with a conclusion error rate of 10%. The standard time calculation obtained is 125.12 minutes for the wire handling process where this can still be improved if the operator is given training.

***Corresponding Author:**

Ayu Nurul Haryudiniarti

Industrial Engineering, Faculty of Information and Science Engineering, Jakarta Global University,
Indonesia, 16412

Email: ayunurul@jgu.ac.id

1. INTRODUCTION

PT. YMH is a company that produces electrical components for motorcycles, snowmobiles, golf carts, outboard motors, general purpose engines in Indonesia. Based on the production report of PT. YMH annually produces 10,000 spools/day, so that in this case, sufficient manpower is needed in pursuing daily production targets. Currently PT. YMH already has a number of employees, namely 1500 people so that with such a large number of employees, it is expected that the production output of PT. YMH always achieves its targets and maintains its productivity.

Productivity is one of the main factors in the company where productivity will affect the production output. If productivity increases, the output of production will also increase and vice versa. This research was conducted on the wire handling process and the method used was work sampling and standard time determination, where previously statistical calculations were carried out to see data uniformity and adequacy. The expected work sampling method is that researchers can see what percentage of the operator's productive and non-productive time is observed. While the results of the calculation of the standard time can be used as

a reference in the work so that efficiency will be obtained which in turn will increase productivity in the wire handling process.

Work Measurement

It is an activity to determine the time required by workers (who have average and well-trained skills) in carrying out work activities under normal working conditions and tempo. The determination of the time in question is the measurement of working time where what is measured is the standard time or standard time. This standard time can be used as a basis for analyzes such as:

- a. Determination of work schedules and planning
- b. Determination of standard costs and as a tool in preparing budgets
- c. Estimated product cost before processing the product
- d. Determination of machine effectiveness
- e. Determination of standard time used as the basis for direct labor intensive wages.
- f. Determination of standard time used as the basis for indirect labor wages.
- g. Determination of the standard time used as the basis for monitoring labor costs.

Work Sampling

Work sampling is one type of indirect work time measurement. Work sampling is carried out by conducting a large number of observations on the work activities of machines, processes and workers. According to Satalaksana, this work sampling method can be carried out momentarily at a randomly determined time. Work sampling can also be used to calculate the proportion of time for productive activities and unproductive activities which are displayed in percentage form.

Standard Time

Satalaksana stated that the standard time is the time required by a normal worker to complete a job that is carried out in the best work system[1]. Meanwhile, Barnes in Yanto and Billy Ngaliman, 2017 explains that standard time is the time it takes for a worker of average ability and well trained to complete a job with a normal working speed and using certain methods.[2]

2. METHOD

The method that will be used by the author is to carry out various methods of discussion to obtain data, including:

a. Field observation

Is a method by making observations that are directly involved with the object, so as to obtain systematic data and in accordance with the purpose of understanding the work system

b. Sampling Introduction

Conduct preliminary sampling in accordance with what has been prepared in the previous step, namely collecting sample data of 40 observations for five working days with operator objects that have average abilities.

c. Statistic test:

- Data uniformity test

Observing the uniformity of the data by determining the control limit and if it is still within the upper and lower control limits (UCL & LCL), the data is uniform, if not, the result is the opposite.

- Data adequacy test,

Namely to see if the number of observations that should have been carried out met or not with a 95% confidence level; S (degree of accuracy) = 3%. [2]

d. Calculating standard time

The calculation of this standard time goes through several steps which include the number of observations, the number of productive, the presentation of productive, the number of minutes of observation, the number of productive minutes, the number of goods produced during the observation, the time required, the normal time, the adjustment factor, allowances and the final result is the standard time.

The adjustment factor using the shumard method, which is work performance is divided into 13 classes, and the performance of workers during observation is compared with work performance when normal or divided by 60 [1]. The adjustment factors are shown in Figure 1 below.

Kelas	p	Kelas	p
Superfast	100	Good -	65
Fast +	95	NORMAL	60
Fast	90	Fair+	55
Fast -	85	Fair	50
Excelent	80	Fair -	45
Good +	75	Poor	40
Good	70		

Figure 1. Adjustment factor according to Shumard method

Allowance factor is factors given to a job to obtain an adequate environmental condition or support the system, consist of three factors, namely:

1. Personal Allowance

- Female workers = 2% - 5% of normal time
- Male worker = 2% - 2.5% of normal time

2. Fatigue Allowance

The ILO (International Labor Organization) in 1957 as quoted by Niebel & Freivalds (2003), stated:
Light work allowance = 4%

3. Delay Allowance

The allowance for unavoidable obstacles or conditions ranges from 10-15%

In order to obtain the allowance factor, the three factors are added together, after that the addition of the allowance factor is used to calculate the desired standard time. [2]

The process flow of the research method shown in Figure 2.

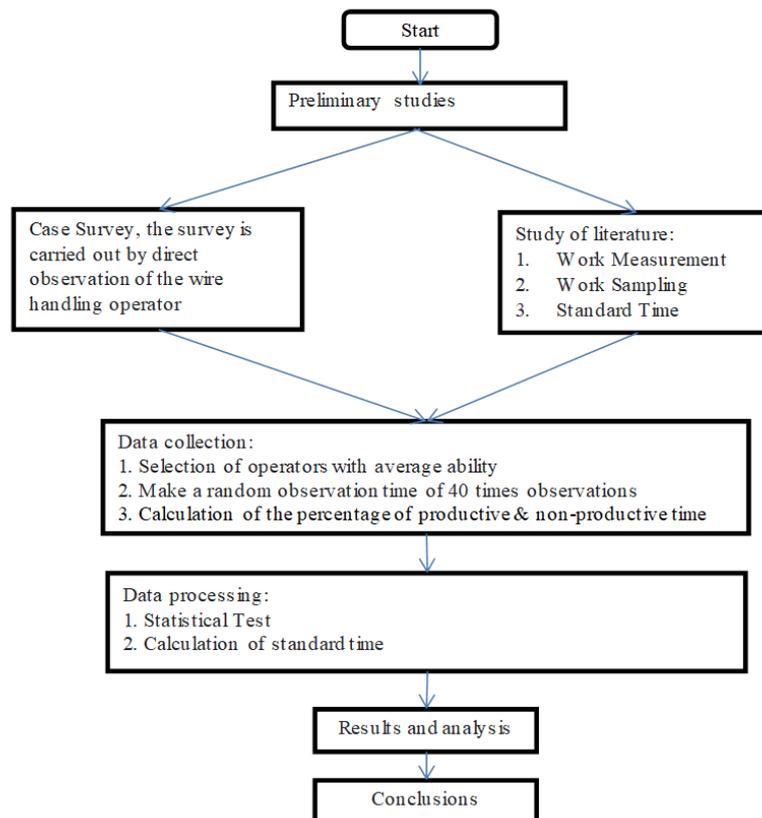


Figure 2. Research process flow

Selection of operator with average ability

After the researchers made direct observations at PT YMH, namely by choosing an operator with an average ability to see work productivity in the wire handling process

Random determination of observation time

By using a table of random numbers, the results are as shown in Figure 2 below where from the table of random numbers that have met the requirements (which are not crossed out), they are sorted from small to large numbers. These results are used to determine the observation time of the selected operator.

39	65	76	45	45	19	90	69	64	61
20	26	36	34	62	58	24	97	95	06
70	99	00	73	71	23	70	99	65	97
60	12	11	31	56	34	19	19	47	83
75	51	33	30	61	38	20	46	72	20
47	33	84	51	67	47	97	19	98	40
07	17	66	23	05					

Figure 3. Strikethrough table of random numbers

By using a table of random numbers, the results are as shown in Figure 1 below where from the table of random numbers that have met the requirements (which are not crossed out), they are sorted from small to large numbers. These results are used to determine the observation time of the selected operator.

Strikethrough table of random numbers

From the table of random numbers above, a table of observations was made in the following way:

- Working time = 08:00-16:00
- If working hours 1 day = 8 hours (08:00 to 16:00)
- Break time = 12:00 to 13:00
- Actual working hours = 8 hours of work – rest time (1 hour) = 7 hours of work
- Length of time unit = 5 minutes
- 1 hour = 60 minutes; length unit of time = 5 minutes
- The number of units of length per hour = 60 : 5 = 12
- Number of observations = 40 times

Determine the time in 40 random observations in work sampling observations with the following conditions, the pair of 2 numbers cannot be more than 84 because the total length of the unit of time observed is 12 x 7 = 84, no repetition and calculation starts from 0.

The random numbers that are not crossed out are listed in figure 3 and the way to read it is to look at the sequence of the random numbers table that is not crossed out, for example 39, then the sequence 39 is marked as the observed visit time, and so on until it reaches 84 observations.

No	visiting hours																
0	08.00	12	09.00	24	10.00	36	11.00	48	13.00	60	14.00	72	15.00				
1	08.05	13	09.05	25	10.05	37	11.05	49	13.05	61	14.05	73	15.05				
2	08.10	14	09.10	26	10.10	38	11.10	50	13.10	62	14.10	74	15.10				
3	08.15	15	09.15	27	10.15	39	11.15	51	13.15	63	14.15	75	15.15				
4	08.20	16	09.20	28	10.20	40	11.20	52	13.20	64	14.20	76	15.20				
5	08.25	17	09.25	29	10.25	41	11.25	53	13.25	65	14.25	77	15.25				
6	08.30	18	09.30	30	10.30	42	11.30	54	13.30	66	14.30	78	15.30				
7	08.35	19	09.35	31	10.35	43	11.35	55	13.35	67	14.35	79	15.35				
8	08.40	20	09.40	32	10.40	44	11.40	56	13.40	68	14.40	80	15.40				
9	08.45	21	09.45	33	10.45	45	11.45	57	13.45	69	14.45	81	15.45				
10	08.50	22	09.50	34	10.50	46	11.50	58	13.50	70	14.50	82	15.50				
11	08.55	23	09.55	35	10.55	47	11.55	59	13.55	71	14.55	83	15.55				

Figure 4. Randomly determined observation times

Based on the table of random numbers above, the results of observations for five days show the percentage of productive and unproductive operators, shown in table 1.

Table 1.

Observation Day	Productive		Non Productive	
	Amount	Percentage (%)	Amount	Percentage (%)
1	32	80%	8	20%
2	32	80%	8	20%
3	33	82,5%	7	17,5%
4	32	80%	8	20%
5	31	77,5%	9	22,5%
Total	160	80%	40	20%

From the results of observations for five days with 40 times per day or a total of 200 observations, it can be seen that operators in the wire handling process carry out productive activities reaching 80% while non-productive 20%. Furthermore, to obtain the standard time from the wire handling process, statistical testing is carried out first.

3. RESULTS AND DISCUSSION (10 PT)

3.1. Uniformity test

In testing the uniformity of the data, determine the control limits, namely the upper control limit (UCL) and the lower control limit (LCL), with the following steps:

First determine \bar{p} which is the number of productive percentage observations

$$\bar{p} = \frac{\sum p_i}{k}$$

p_i = i-day productive percentage

k = number of observation days

$$\bar{p} = \frac{(80 + 80 + 82,5 + 80 + 77,5)\%}{5} = 80\% = 0,8$$

Second, determine the value of \bar{n} which is the average number of days of observation

$$\bar{n} = \frac{\sum n_i}{k}$$

n_i = number of observations on day i

k = number of observation days

$$\bar{n} = \frac{40 + 40 + 40 + 40 + 40}{5} = 40$$

After obtaining \bar{p} and \bar{n} values, calculate UCL & LCL

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

$$UCL \& LCL = 0,8 \pm 5 \sqrt{\frac{0,8(1 - 0,8)}{40}}$$

$$= 0,8 \pm 5 \sqrt{\frac{0,16}{40}} = 0,765 \pm 5(0,06)$$

$$= 0,8 \pm 0,3$$

$$UCL = 0,8 + 0,3 = 1,1$$

$$LCL = 0,8 - 0,3 = 0,5$$

Percentage of productive on the first to fifth day: 0.80 ; 0.80 ; 0.825 ; 0.80 ; 0.775

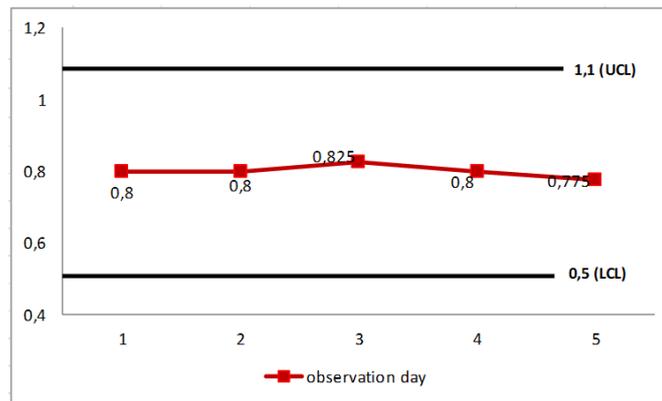


Figure 5. Uniformity test

The graph above illustrates that the data on the proportion of workers' productive time from the first to the fifth day is still within the UCL and LCL limits, so it can be said that the observation data is uniform.

3.2. Adequacy test

The number of observations or the adequacy of data is carried out using the following formula:

$$S.p = 2 \sqrt{\frac{p(1-p)}{N}}$$

p = The percentage of the proportion of productive activities expressed in decimal numbers

S = dDesired level of accuracy in decimal numbers

N = Number of observations required

With a 95% confidence level, an accuracy level of 10%, and the proportion of productive activities 80% or 0.80 the results obtained are:

$$0.1p = 2 \sqrt{\frac{p(1-p)}{N}} = 0.01p^2 = 2^2 \frac{p(1-p)}{N} = \frac{4p(1-p)}{N}$$

$$N = \frac{4p(1-p)}{0,01p^2} = \frac{400(1-p)}{p} = \frac{400(1-0,80)}{0,80} = 100$$

3.2.1. Calculating standard time

The wire handling process is a sub-process of the coil production process with a capacity of 10,000 coils/day or 23.83 ~ 24 coils/minute. The adjustment factor using the shumard method where the operator has average expertise, the value is $75/60 = 1.25$ or 125%, while the leeway factor results in $5\% + 10\% + 15\% = 30\%$. The calculation of the standard time of the wire handling process has several stages, namely: [3][4][5]

- a. Determine productive time (Pt)

$$Pt = \frac{\text{Number of productivity}}{\text{Number of observations}} = \frac{160}{200} = 0,8$$

- b. Determine the number of productive minutes of work elements (Mw)

$$\text{Total minutes of observation} = 5 \text{ days} \times 7 \text{ hours} \times 60 \text{ minutes} = 2100 \text{ minutes}$$

$$Mw = Pt \times 2100 \text{ minutes} = 80\% \times 2100 \text{ minutes} = 1680 \text{ minutes}$$

- c. Determine Cycle Time per unit (Ct)

$$Ct = Mw / \text{Number of productions/minute} = 1680/24 = 70 \text{ minutes/unit}$$

- d. Determine the normal time (Nt)

$$Nt = Ct \times 125\% = 70 \text{ minutes/unit} \times 125\% = 87.5 \text{ minutes/unit}$$

- e. Define standard time (St)

$$St = Nt \times (100/(100-\text{allowance factor}))$$

$$\begin{aligned} St &= Nt \times 30\% = 87.51 \text{ minutes/unit} \times (100/100-30) \\ &= 87.5 \text{ minutes/unit} \times 1.43 \\ &= 125.12 \text{ minutes/unit} \end{aligned}$$

4. CONCLUSION

Based on the analysis of the data collected through sampling observations and carried out several stages of data processing, several conclusions are drawn, namely: 1). The results of work sampling observations for 5 days for 40 observations obtained the results of productive activities as many as 160 of 200 observations or 80 % and non-productive activities by 40 out of 200 observations or by 20%.

After statistical testing for data uniformity showed that the observation data from the first day to the fifth day, namely (1) 0.80 (2) 0.80 (3) 0.825 (4) 0.80 (5) 0.775 was still within the upper control limit and lower control limit, respectively. 1.1 and 0.5 respectively. The number of observations required from the calculation results is 100 observations, while the observations that have been made as many as 200 observations, then the number of observations is sufficient. Sampling the work that has been done can be concluded that with a 95% confidence level the percentage of working time that can be utilized by workers productively is 80% with a conclusion error rate of 10%.

The calculation of the standard time obtained is 125, 12 minutes for the wire handling process, where this can still be improved if the operator is given training so that from the beginning the average ability becomes above average ability.

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