Workload analysis of chemical analyst at Analytical Research Laboratory PT.UPA – Orang Tua Group

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Abstract. The accuracy of the job completion is very important to increase productivity. PT.UPA-Orang Tua Group has a chemical analysis laboratory (Analytical Research Laboratory) which is tasked analyzing samples from Formulator Divisions. In carrying out the sample chemical analysis, the company has 10 working days lead time. But it was seen that a number of samples were handled beyond the 10-day deadline. This is thought to be a chemical analyst's workload that exceeds its capacity. In this study, workload will be calculated using the Workload Analysis method and also set a standard time for chemical analysis in which the company does not have it. The object of this research is to determine the standard time taken from the preparation of chemical analysis of each parameter. There are 8 chemical parameters that will be calculated. Then observation of work time were carried out by a chemical analyst with good abilities and moderate work rhythms. Determination of the standard time for chemical analysis is 24.07 hours per sample. And the workload for each analyst is 7 samples per month, so it takes 11 chemical analysts to complete 639 samples that will come to meet the 10-day work target.

Keywords: AR Laboratory, chemical analyst, standard time, workload analysis

1. Introduction

Companies can win the competition if they are always looking for ways to move forward. One of the factors to find out whether a company is said to be advanced or not, can be seen from its productivity growth. Productivity is the number of units of goods or services made by a worker in a certain time using various types of machinery and equipment available at his place of work [5]. Productivity cannot be measured if a company does not have a standard. A standard is usually the first step in determining the needs of workers. A good standard must show the level of optimal achievement that must be performed by workers. Standards are often equated with standard time because the size to determine a standard can be seen from the standard time. Taylor defines that standard time is the main basis for showing productivity [3]. Standard time is the time needed by the average worker to do work under normal conditions [6]. So that if the time standard is correct, then the time standard can represent the time needed by a worker to carry out his work.

Orang Tua Group is one of the companies engaged in food and beverages in Indonesia. The Orang Tua Group subsidiary which is in control of producing food commodities such as wafers, biscuits,
chocolate, candy and nuts is PT. Ultra Prima Abadi. PT. Ultra Prima Abadi has a research laboratory
centre (Analytical Research Laboratory / AR Lab) which is tasked with analyzing the chemistry of
every product that has been released.

The AR laboratory has 7 analysts in charge of analyzing sample chemistry. AR laboratory
customers are all divisions that are developing company products. These divisions are called Front
End divisions. All products that have been sent by Front End will be analyzed by chemical analysis
consisting of various analysis parameters.

AR laboratory has a deadline for working on the sample analysis for each application for analysis
is a maximum of 10 working days, but the company does not have a standardized working time
analysis for each analysis parameter. With this deadline every month, AR laboratories are still
experiencing some delays.

During the period June 2016-March 2017, the average sample that came every month was 1916
samples. During this period there were several samples that were not completed on time. The average
sample that was successfully analyzed on time (On Due Date Sample) during that period each month
was only 75.33%. This amount has not met the company's expectation of 100% On Due Date Sample.

Delay in analysis can cause large number of samples queued to be tested in the AR laboratory. The
sample accumulation that caused the Front End division also experienced delays in the process of
developing new products so as to provide a significant impact on the company's productivity in the
form of customer complaints. The average number of customer complaints to AR laboratories during
the period June 2016-March 2017 is 60 complaints each month. When compared with the number of
overdue samples (the sample completed is more than the 10-day deadline) then the average customer
complaint that is included consists of 7-8 overdue samples per customer. This large number of
complaints must be immediately addressed by efforts to increase work productivity in the AR
laboratory.

In an effort to increase work productivity in the AR laboratory, it is necessary to measure
workload. Productivity will not increase if the workload of each employee is uneven. Workloads that
are too heavy or light will have an impact on work inefficiency [3]. Workload that is too light means
that there is an excess of labor which causes the organization to pay more employees with the same
productivity resulting in cost inefficiencies. Conversely, if there is a shortage of labor, it can cause
physical and psychological fatigue for employees, so that employees become unproductive because
they are too tired.

Until now, AR laboratories have never calculated workload analysis through standardization of
work time. The standard time must be determined in the calculation process of the chemical analyst
workload analysis. Therefore, it is expected that by researching and analyzing the analyst workload
will produce optimal output so that AR laboratory productivity will increase and the distribution of
workload between analysts is evenly distributed.

The purpose of this study is to determine the standard time of sample analysis in the AR laboratory,
to find out the maximum workload that can be given to chemical analysts based on workload analysis,
and knowing the number of analysts needed.

2. Methods
The data needed in this study include:

a. The measurement of standard time of the analysis was only carried out on 8 chemical parameters,
   that are pH analysis, moisture content, reducing sugar content, total sugar content, fat content,
   protein content, total acid levels and salt levels.

b. The observation of work time required by a chemical analyst in completing the analyze using
   stopwatch.

c. Number of samples received in the Analytical Research (AR) laboratory for analysis of 8
   parameters during the period June 2016 - March 2017. This data will be used to estimate the
   number of samples arrivals in the AR laboratory during April-December 2017

d. Working hours available for April - December 2017
e. Job description of chemical analyst in the AR laboratory.

f. Number of AR laboratory chemistry analysts.

Data processing and analysis are carried out with the following stages:

a. Determine the cycle time, normal time and standard time of the chemical analysis process. At this stage, the calculation of the cycle time has passed the uniformity and adequacy test data. Normal time is obtained from the adjustment of cycle time to the skills, effort, and consistency of analysts and the work atmosphere.

b. Estimating the number of sample arrivals per month during April - December 2017. In this study the forecasting method used is a geometric increase with a formula [1]:

$$ P = P_0 (1 + \frac{i}{100})^n $$

(1)

P forecasting value of the n-th period, $P_0$ the value of the n-th period, $i$ average increase in percent, n number of periods predicted.

Determine analyst workload. In this stage the number of samples that can be done by one chemical analyst per day will be calculated. The purpose of this calculation is to determine a realistic target so that there is no excessive sample load received by chemical analysts. Analysts workload calculation using the formula [7]:

$$ \text{Standard workload} = \frac{\text{Time available}}{\text{average completion time}} $$

(2)

Determine the number of chemical analysts based on the following equation [7]:

$$ \text{Number of analysts needed} = \frac{(\text{standard time per unit \times number of units})}{\text{time available per person}} $$

(3)

From these calculations it can be seen whether the company needs to increase the number of analysts so that the work target can be achieved without giving excessive workload in accordance with the arrival of the number of samples.

3. Result and Discussion

3.1. Job description of chemical analysts in the AR laboratory

The details of the responsibility of the chemical analyst in the AR laboratory are:

a. Conduct routine chemical analysis for product samples from the Front End division.

b. Calculate and input the results of chemical analysis into the analysis report.

c. Evaluate and ensure the actual analysis is in accordance with the work instructions that apply in the AR laboratory.

d. Record the use of chemical reagents and equipment used in the chemical analysis process in the log book of use.

3.2. Number of chemical analysts in the AR laboratory

The number of chemical analysts in the AR laboratory is 7 analysts. All analysts will be distributed samples every day with the same quota for each person according to the arrival of the sample number.

3.3. Determination of standard time

The work carried out in the AR laboratory is the analysis of the content of chemical compounds contained in the sample (consisting of 8 test parameters), data calculation, and report making. In the completion of the chemical analysis, each sample requires the preparation of a simultaneous work system, so some analysis can be done at the same time. The working cycle time of the sample is obtained from the longest cycle time of the parameters tested where the longest cycle time occurs in the analysis of protein content for 23.07 hours. In the protein analysis there is a treatment of sample curing for 20 hours in the machine which causes the protein analysis has the longest cycle time.
In the process of chemical analysis, the first stage is to prepare equipment for water content analysis that requires a process on the machine for 1.5 hours. During the process on the machine, the chemical analyst will use the time to work on the preparation for the analysis of fat and protein then proceed with the analysis of total acid. When the process in the machine occurs in the analysis of protein and fat, then the time will be used to analyze the pH and salt content in the sample. Continued with the analysis of reducing sugars and analysis of total sugar. Then complete the analysis of fat and protein. The last stage is data calculation and report making. So that the standard time for the completion of chemical analysis is the sum of the standard time’s protein analysis (the longest standard time), the calculation of the data, and the making of the report that is equal to 1480.28 minutes or 24.67 hours per sample. To explain the activities of the analysis carried out simultaneously, it can be seen at fig.1 Gantt Chart of the chemical analysis process in the AR laboratory. The grey color identify that the activities or operations are done by machineries and the yellow color identify that the activities or operations are done by operators.

**Figure 1. Gantt Chart of Chemical Analysis Process**
3.4. Forecasting the number of samples
Forecasting the number of samples to be received in the AR laboratory during the April - December 2017 period is carried out using the geometric increase forecasting method. Forecasting results can be seen in table 1.

| Month   | Number of sample |
|---------|------------------|
| April   | 63               |
| May     | 65               |
| June    | 67               |
| July    | 69               |
| August  | 71               |
| September | 73            |
| October | 75               |
| November| 77               |
| December| 80               |
| Total   | 639              |
| Average | 71               |

3.5. Workload analysis
Determination of workload based on the calculation of the number of samples that can be done by one chemical analyst in 8.5 working hours with the standard time required to complete one sample is 24.07 hours. Based on these data, the maximum number of samples that can be done by a chemical analyst can be calculated using equation (2) as follows:

\[
\text{Workload} = \frac{8.5 \text{ hours per day} \times 20 \text{ day per month}}{24.67 \text{ hours per sample}} = 7 \text{ sample/month/analyst}
\]

Calculation of chemical analyst needs in the AR laboratory to be able to complete all samples received using equation (3) as follows:

\[
\frac{24.67 \text{ hours per sample} \times 639 \text{ sample}}{178 \text{ days} \times 8.5 \text{ hours/day per analyst}} = 10.42 \sim 11 \text{ chemical analyst}
\]

The number of chemical analysts required by calculation is 11 chemical analysts, while the number of chemical analysts is currently only 7 people. This amount is inadequate when compared to the number of samples that will be received during the April-December 2017 period.

4. Conclusion
a. Based on research conducted in the laboratory of Analytical Research PT. UPA - Orang Tua Group can be concluded as follows:

b. The estimated number of sample arrivals during the April-December 2017 is 639 samples.

c. Based on the results of processing data from observations of chemical analysis work obtained a standard time of 24.07 hours or 2.9 days per sample with 8 parameters.

d. The maximum workload that an analyst can work on is 7 samples per month.

e. The number of analysts needed to complete the samples that will be come during the April-December 2017 period were 11 chemical analysts. With the availability of the current number of chemical analysts, there are still four additional chemical analysts needed to complete work targets.
5. References

[1] Gawatre 2016 Comparative Study of Population Forecasting Methods *IOSR Journal of Mechanical and Civil Engineering* (IOSR-JMCE) e-ISSN: 2278-1684 p-ISSN: 2320-334X 13(4V) (July - Aug. 2016) pp 16-19

[2] Isman 2013 *Analisis Beban Kerja di Laboratorium Finger Print PT. PPLi* (Jakarta: Program Studi Teknik Industri Universitas Pancasila)

[3] Ko C S, Cha M S and Rho J J 2007 A Case Study for Determining Standard Time in a Multi-pattern and Short Life-cycle Production System. *Computers & Industrial Engineering* 53(2) pp 321-325

[4] Mangkuprawira 2004 *Manajemen Sumber Daya Manusia Strategik* (Bogor: PT. Ghalia Indonesia)

[5] Pardede 2007 *Manajemen Operasi dan Produksi: Teori, Model dan Kebijakan* Revisi ed (Yogyakarta: Penerbit Andi) p 373

[6] Russel R S and Taylor B W 2011 *Operations Management* 7th Ed. (River Street NJ: John Wiley & Sons) p 348

[7] Wignjosoebroto S 2000 *Ergonomi Studi Gerak dan Waktu Teknik Analisis untuk Peningkatan Produktivitas Kerja.* 1st Ed. (Surabaya: Penerbit Guna Widya)