The Analysis of Productivity at PT. Perkebunan Nusantara IV Unit Teh Bah Butong

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Abstract

PT. Perkebunan Nusantara IV Teh Bah Butong Business Unit, a company that produces products in the form of powdered tea, is one of the companies that continues to grow. Based on observations made in the production processing section, the tea production process often experiences problems. One of the causes is the declining performance of the factors of production, namely equipment. This declining performance of production factors is the cause of the loss of productive time within a certain time. Economically, this would be counter-productive to efforts to meet the company's production targets. This problem will be analyzed by measuring the overall effectiveness of production factors or machines (OEE method), as an important part of a series of industrial production processes. From the calculation results, the level of effectiveness of the production system performance according to world-class benchmark standards has not yet reached the specified standard. In measuring effectiveness, the average performance is 67%. This figure can actually be increased, so that it shows the production performance as targeted by the corporation.

I. Introduction

The development of business competition constantly requires the leadership of manufacturing companies to monitor the performance of each of their business functions, including the production and maintenance divisions to gain a competitive advantage. One of the factors supporting the success of the manufacturing industry is determined by the smooth production process. So that if the production process is smooth, it will produce quality products, the right time to complete the manufacture of products, and low production costs. The process is very dependent on the condition of the resources owned, such as humans, machines, or other supporting facilities, where the condition in question is a ready-to-use condition to carry out the production process both in terms of accuracy, capability, or available machine capacity.

The stoppage of a production process is often caused by a problem in the production facility, for example, machine failures that were not detected during the production process. This can be detrimental to the company, namely, there will be costs that will be incurred by the company due to damage. One of the problems that often occur in the production department is how to carry out the production process as efficiently and effectively as possible so that the production process can run well. The conditions in the field that have occurred so far are the frequent occurrence of Downtime and Loss of time on the Vibro machine, Availability is closely related to breakdown and adjustment/set up on a machine before packing. Based on the problems mentioned above, this study aims to

analyze the process of measuring the productivity of the Vibro machine using the Overall Equipment Efficiency (OEE) approach.

II. Review of Literature

2.1 Production Factors

Factors of production are things needed to create goods or services. Factors of production can be land, labor, and capital. These three things are the earliest factors of production discussed by political economists in the classical era. Political economists such as Adam Smith, who is known as a developer of capital as the main axis of the production system, is the most popular example through his book "The Wealth of Nations". Then the factors of production were used as the basis for criticism of economic politics through several other experts such as Karl Marx who criticized the accumulation of capital and added value to labor, and David Ricardo who then gave birth to the principles of political economy and taxation of factors of production.

In its development, the three main factors of production were added with a new factor called entrepreneurship. These four factors of production then become a combination for the process of producing goods and services in generating economic benefits. These factors of production are of course limited by several things, such as the natural aspects of a country or region. This then makes a country make an efficient allocation of resources as a factor of production.

The ownership of the factors of production is determined by the economic system adopted by each country in which the business actor establishes his business. Apart from labor factors, almost all ownership of factors of production varies according to the type of industry and this economic system. If judging from the type of industry, for example, a company operating in the property or real estate sector will generally own several plots of land which are then used as factors of production and sold. Meanwhile, retail or roko companies rent land for a certain period of time as a factor of their production. In this case, the real estate entrepreneur becomes the owner of the factor of production from the land he leases, although partially the owner of the retail business also considers the land as a factor of their production.

In addition to the type of industry, the main influence that determines who owns the factors of production is the economic system. If a country adopts a socialist economic system, then the factors of production can be owned by anyone for the common good. Meanwhile, for a capitalist economic system, each factor of production can be owned by everyone individually or privately for the purpose of personal gain. It is different with the communist economic system, where the factors of production are owned by the state for the common good.

In the process of business development, every business actor requires more modern and comprehensive production factors. This is necessary because business competition in this digital era is getting tougher and market conditions are increasingly diverse, both physically and in cyberspace. The following are 5 contemporary production factors needed in business development in this digital era,

a. Labor Factors (Human Resources)

This classic production factor is one of the backbones of a very important business or business. Product processing and production operational processes require a skilled and reliable workforce. Likewise, the marketing process and various other matters related to the sale of products or services also require the role of human resources as a factor of production. The workforce acts as a product processor and also in the operation of the means of production. Even when the modern production process has been assisted by artificial intelligence, human resources are still needed. The existence of emotions, feelings, and the soul of humans makes the resulting product more suitable for consumers.

b. Natural resource factor

For those who have a business or industry in the manufacturing sector, the existence of this factor of production is very important. Raw materials in the manufacturing production process become raw materials for processing products that will later be marketed. These natural resources vary by industry, but generally land or land and water are the main factors for natural resources.

For example, a company engaged in the cooking oil industry will need natural resources in the form of land to create oil palm plantations. From there then palm oil is obtained to be processed in a factory which also stands on a land as their main production factor.

c. Capital factor

Another important factor for business actors is capital or capital. It can be said, capital is the main driver of business operations from start to finish. Capital in the form of capital or investment from business investors is often used to support a large industry. This capital will later be used as the cost of buying land, building a production site, buying production equipment, and paying the wages of workers.

Capital also has a big influence on the creation of high-quality products. Not only that, with sufficient capital, business actors can also do product marketing properly and on target in order to achieve maximum profit.

d. Entrepreneurial factor

Entrepreneurial factors are often referred to as business management or management factors. This type of production factor determines the running of the business process as a whole, especially in the internal realm. The division of labor and the operation of producing goods or services require this type of production factor to be organized and run effectively. The efficiency of labor and raw materials also needs to be regulated in such a way with this type of production factor. This is because, through proper management, a production process will run more efficiently. Work and operational efficiency will also affect the company's ability to respond to consumer demand, so that the resulting product does not experience obstacles.

In addition, these production factors also support the company's financial management process in general. Financial management is one part of this entrepreneurial production factor. The existence of qualified financial management can support the company's performance so as not to plan too large a budget or increase the expected profit achievement.

e. Technology and information factors

This last production factor is very relevant to the conditions of the current digital era. Through this technology and information, business actors can ease their work processes. Technology and information can be used for workforce management, finance, and marketing processes. The existence of applications and software that is developed as the business grows can support the company's achievements.

In addition, with the existence of information technology, a company can cut some costs that may have weighed heavily on them in the past, such as distribution and promotion costs. The existence of various application-based online sales platforms and online package services can actually simplify the marketing process more broadly.

Through the example above, it can be seen that the factors of production in every business have a broad scope. Each factor of production can be privately owned or rented for a certain period of time. In fact, several companies are also engaged in providing outsourced labor for the process of factory construction and non-essential company operations, such as factory firefighters to cleaning or maintenance.

So, that was what and how the factors of production played a role in business development. The existence of production factors is something that must be carefully prepared by business actors in their business planning. This will make it easier for business people to prepare or develop their business strategies going forward. Moreover, the

existence of production factors also determines the quality of the product or service that will be produced by a business.

2.2. Understanding Overall Equipment Effectiveness (OEE) Of Productivity

The overall equipment effectiveness (OEE) method is an activity to measure the performance of production machines by implementing total product maintenance (TPM). This method activity has three main component policies in applying the OEE method to the production of the machine, such as availability, performance, and quality. According to Nakajima, (1988), OEE is a method used as a metric in the application of the TPM program to maintain equipment in ideal conditions by eliminating six big losses.

Quality in OEE can also be referred to as the number of good product units that have been successfully produced compared to the total number of product units (either OK units or defective units) produced. And than, the maintenance or better known as maintenance can be defined as an activity. Limitations of determining the ideal OEE values for manufacturing companies followed globally can be seen in the table below:

Description	Value
Availability	>90%
Performance	>95%
Quality	>99%
OEE	>85%

2.2. Losess And Productivity

Six equipment losses cause low performance of machines and equipment.The six losses are known as the six big losses and described as (1) Breakdown Due To Equipment Failure, (2) Setup and Adjustment, (3) Idling and Minor Stoppages, (4) Reduced Speed, (5) Defects In Process and Rework, (6) Reduced Yield

III. Research Method

3.1 Analysis Method

The steps of the overall equipment effectiveness (OEE) method are as follows: (1) Calculating the Availability ratio, (2) Calculating the value of loading time, (3) Calculating downtime, (4) Calculating the value of operation time, (5) Calculating the value of performance rate ratio, (6) Calculating the ideal value of cycle time Ideal cycle time, (7) Calculating the value of the actual cycle time, (8) 8.Calculating the Overall Equipment Effectiveness (OEE) value.

3.2 Data Processing

The data needed for the analysis of productivity calculations on Vibro machines using the Overall Equipment Effectiveness (OEE) approach at PT. Perkebunan Nusantara IV Unit Teh Bah Butong Units include:
Employee Hours:

Table 1. Employee Hours of PTP IV Teh Bah Butong Unit

No	Month	Number of working days	Productive working day	Non-productive day	Number of shifts
1	January	31	25	6 day	2
2	February	28	23	5 day	2
3	March	31	26	5 day	2
4	April	30	25	5 day	2
5	May	31	23	8 day	2
6	June	30	25	5 day	2
7	July	31	26	5 day	2

Source: Data Perkebunan *from PT. Nusantara IV*
Teh Bah Butong Unit

Production Data:

PT. Perkebunan Nusantara IV Bah Butong Teh Unit has a daily production of ± 100 tons of wet tea leaves per day. Where this production runs every day, it will only stop on Mondays due to routine machine maintenance carried out.

Table 2. Production Data PT. Perkebunan Nusantara IV Teh Bah Butong Unit

Month	Production Quantity (Kg)	Defect (Kg)
January	485.272	12.988
February	363.040	10.682
March	471.883	11.750
April	446.350	21.043
May	420.495	19.732
June	534.740	29.127
July	478.028	28.044
Total	**3.199.808**	**133.366**

Source: Data from PT.Perkebunan Nusantara IV Teh Bah Butong Unit

Data Downtime

On the vibro data plan machine, the downtime is 3 hours per day, while the machine setup per day is 10 minutes. The downtime data on the Vibro machine for the period January-July 2021 can be seen in the table below:

Table 3. Vibro Machine Downtime Data 2021

Month	Available Time (Hours)	Planned Downtime (Hours)	Set Up (Hours)	Failure & Repair (Hours)	Downtime
January	358	75	4	20	24
February	299	70	4	18	22
March	350	78	4	19	23

April	355	75	4	18	22
May	322	69	4	22	26
June	382	75	4	17	21
July	350	78	4	20	24
Total	**2416**	**520**	**28**	**134**	**163**

Source: Data from PT. Perkebunan Nusantara IV Teh Bah Butong Unit

IV. Result and Discussion

4.1 Availability Ration Calculation

The following is the calculation of the availability ratio for January 2021 and the availability ratio for January-July 2021 is presented in the table below:

Month	Loading Time	Downtime	Operation Time	Available Ratio
January	283	24	258	91%
February	230	22	208	91%
March	272	23	249	91%
April	280	22	258	92%
May	253	26	227	90%
June	308	21	286	93%
July	272	24	248	91%

4.2 Performance Rate Ratio

A performance ratio is a ratio that describes the ability of the equipment to produce goods. The calculation of the performance efficiency ratio begins with calculating the ideal cycle time of a production machine. The following recapitulation of the results of the calculation of the performance efficiencyratio of the Vibro engine in January-July 2021 can be seen in the table below:

Month	Operation Time	Output (Kg)	Ideal Cycle	Actual Cycle	Performance Ratio
January	258	485.272	0,00041	0,00053	77%
February	208	363.040	0,00041	0,00057	72%
March	249	471.883	0,00041	0,00052	78%
April	258	446.350	0,00041	0,00057	71%
May	227	420.495	0,00041	0,00054	76%
June	286	534.740	0,00041	0,00053	77%
July	248	478.028	0,00041	0,00051	79%

Source: Data from PT. Perkebunan Nusantara IV Teh Bah Butong Unit

4.3 Calculation of Rate of Quality Product

Quality ratio or Rate of Quality Product is a ratio that describes the ability of equipment to produce products that comply with standards. The following recapitulation of the calculation results of the Rate Of Quality Product from the Vibro machine in January-July 2021 can be seen in the table below:

Month	Output (Kg)	Riject (Kg)	Rate of Quality Product

January	485.272	12.988	97%
February	363.040	10.682	97%
March	471.883	11.750	98%
April	446.350	21.043	95%
May	420.495	19.732	95%
June	534.740	29.127	95%
July	478.028	28.044	94%

Source: Data Processing (2021)

Based on Table above it is known that the Rate Of Quality Products every month has an average percentage value of 96%. Rate Of Quality Product is influenced by the number of production results and the total number of defects in the product. Based on the results of observations (observations) it was found that during the production process there were slight defects in the product this was due to the processed products in the form of semi-finished goods, which would later be reprocessed.

4.4 Calculation of Overall Equipment Effectiveness (OEE) Value

This OEE measurement is based on the measurement of three main ratios, namely Availability Ratio, Performance Efficiency Ratio, and Rate of Quality Product. Calculation of OEE value in January-July 2021. The following is a recapitulation of the results of calculating the OEE (Overall Equipment Effectiveness) value of the Vibro engine in January-July 2021 in Table below:

Month	Available Ratio	Performance Ratio	Rate of Quality Product	OEE
January	91%	77%	97%	69,66%
February	91%	72%	97%	63,88%
March	91%	78%	98%	70,49%
April	92%	71%	95%	63,29%
May	90%	76%	95%	66,00%
June	93%	77%	95%	68,51%
July	91%	79%	94%	68,93%
Total	**639%**	**530%**	**671%**	**470,76%**
Average	**91%**	**76%**	**96%**	**67%**

Source: Data Processing (2021)

Based on Table above it is known that the OEE value is obtained by multiplying the values of the three ratio factors, namely the Availability ratio, Performance Efficiency Ratio and Rate of Quality Product. Based on the calculation results, in Table 5.4 it is known that the OEE value does not meet the World Class Benchmark standards for each month

4.5 Comparison of OEE Values at PT. Perkebunan Nusantara IV Unit Teh Bah Butong Unit with International Standard OEE Value

The OEE value that has been obtained is compared with the standard OEE value of the Benchmark Word Class which is the standard value of each factor. The following is a comparison of the OEE values and the Standard Benchmark work class as shown in this table.

OEE Factor	OEE Value Standard Benchmark Word Class	Vibro Engine OEE Value
Availibility Ratio	>90	91%
Performance Efficiency Ratio	>95	76%
Rate of Quality Product	>99	96%
OEE	>85	67%

Source: Data Processing (2021)

Based on Table above it can be seen that the average calculation value of the Availability Ratio for the Vibro engine has reached the World Class Benchmark standard, while the Performance Efficiency Ratio and Rate of Quality Product values have not reached the World Class Benchmark standard. The Overall Equipment Effectiveness (OEE) value for the Vibro engine does not meet the existing World Class Benchmark standards. Where the value of 67% production is considered reasonable but shows there is a large room for improvement.

IV. Conclusion

Based on the results of calculations and analyzes that have been carried out, conclusions are obtained by the research objectives, namely:

1. From the OEE calculation, the effectiveness of the Vibro machine according to the world-class benchmark standard can be said to be not good, this can be seen from the OEE score with an average percentage of 67%. Where according to world-class benchmark standards is considered reasonable, but shows there is a large room for improvement.

2. The low value of OEE obtained is caused by the low value of the performance rate, which is 76%, therefore the suggestions are given to the company to improve the performance of the Vibro engine are: (a) Carry out maintenance activities by always checking the engine and routinely providing lubricants to engine parts, (b) Provide spare parts stock so that handling when the machine cannot operate does not require a long handling time, (c).Conduct regular training and training for operators related to the work and responsibilities that have been given, (d) Require operators to clean the work area before and after production.

The following are suggestions that can be given to PT. Perkebunan Nusantara IV Teh Bah Butong Units are as follows: (a) Companies can perform OEE calculations for other types of machines to know the overall effectiveness of the equipment using continuous evaluation and continuous improvement, (b) The company should provide training on handling problems to operators to improve the ability and expertise of operators in overcoming problems that exist in each machine.

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