



## INCREASE PRODUCTION OUTPUT ON TWA 1342 MACHINE WITH OVERALL EQUIPMENT EFFECTIVENESS (OEE) METHOD (CASE STUDY: PT XYZ BATAM)

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### Abstract

PT XYZ Batam is a manufacturing company that produces NTC (Negative Temperature Coefficient) Sensors. This company has a Chip Dicing Department which is cutting the NTC substrate into chips and then measuring process, measuring process is checking process based on the chip resistance value by the TWA 1342 machine.

Currently, the output of measuring process is not stable, so this study aims to determine the cause of low output and how to increase production output on the TWA 1342 machine with Overall Equipment Effectiveness (OEE) method. The results obtained based on calculations on the TWA 1342 machine are : availability value 95.12%, Performance value 85.06%, Quality value 98.97% and OEE value 80.08%.

Based on the Pareto chart, the cause of output target being not achieved was due to a filter was not suitable for use, because there were tears on the surface of the filter so the dirt was not filtered properly. And the action taken based on the fishbone diagram analysis is to replace the filter periodically and control it by having a filter change record.

After the corrective steps have been taken, the changes in the OEE value on the TWA 1342 machine for one week of observation are as follows: Availability value 99.69%, Performance value 98.10%, Quality value 99.15%. And the OEE value is 96.96%. The percentage of the total output during the week of observation after corrective steps was taken is 98.10%. Where there is an increase in output of 13.04%.

**Keywords :** Overall Equipment Effectiveness (OEE), Pareto chart, fishbone diagram

### 1. Introduction

Almost all of the production processes that take place in a manufacturing industry use machines and equipment. The more often machines work to achieve production targets which sometimes exceed capacity, this can reduce machine capability, reduce machine life and often require replacement of damaged components<sup>[2]</sup>. If the machine or equipment used is damaged, the production process

will be hampered. Overall Equipment Effectiveness (OEE) is a method that can be used to measure machine effectiveness based on the measurement of three main ratios, there are : availability, performance efficiency, and rate of quality<sup>[4]</sup>.

Based on the author's observations, the current output of the measuring process is not stable. It can be seen in the daily output measuring graphic below.

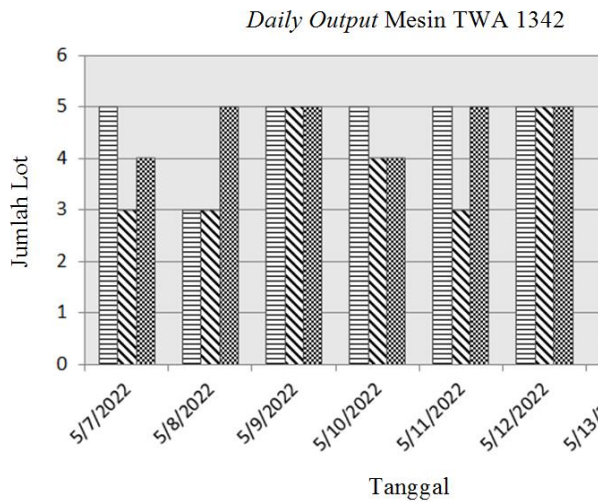


Figure 1. output data TWA 1342 machine on May 2022

The difference in output per day causes delays in the delivery plan targets that have been made, so that at the end of the week, materials will accumulate in this process. The company's production target is 5 lots in one work shift.

OEE plays an important role in identifying the causes of the problem of not achieving production targets. Thus, this study will discuss the use of the TWA 1342 machine OEE measurement technique at PT XYZ Batam. The results of the OEE will be a reference to determine the direction of improvement needed for the machine. Then determine the cause of low output of production machines based on the results of OEE using Pareto charts and determine the increase in output using fishbone diagram analysis.

## 2. Methods

### 2.1 Data collection

The data collected is primary data for 10 weeks at XYZ Batam on April – June 2022 which operates every day for 3 shifts, 7 days/week. The data collected include :

- 1) Machine working hours data
  - a. Working time
  - b. Planned Downtime
  - c. Broken Machine Time
  - d. Production Time Available
  - e. Actual Production Time
- 2) Production Result Data
  - a. Possible numbers of units manufactured
  - b. Number of units manufactured
  - c. Number of defect
- 3) The frequency of breakdown machine unit Data

### 2.2 Overall Equipment Effectiveness (OEE)

Calculate value of Overall Equipment Effectiveness (OEE) for the TWA 1342 machine. The calculation of OEE depends on three main ratios, Availability, Performance, and Quality. Based on this, to get the OEE value, the value of the three ratios must be obtained first<sup>[1]</sup>.

$$\text{Availability} = \frac{\text{Total Time Available} - \text{Down Time}}{\text{Total Time Available}} \quad (1)$$

$$\text{Performance} = \frac{\text{Number of units manufactured}}{\text{Possible number of unit manufactured}} \quad (2)$$

$$\text{Quality} = \frac{\text{Number of unit manufactured} - \text{Number of defect}}{\text{Number of unit manufactured}} \quad (3)$$

$$\text{OEE} = \text{Availability} \times \text{Performance} \times \text{Quality} \quad (4)$$

### 2.3 Pareto chart

This Pareto chart is an image that sorts the data classification from left to right according to the order of highest to lowest rank. This can help find the most important problems to be resolved immediately (highest ranking) to problems that do not need to be resolved immediately (lowest ranking)<sup>[3]</sup>.

### 2.4 Fishbone diagram

Fishbone diagram depict lines and symbols that show the relationship between the effects and causes of a problem. The diagram is indeed used to determine the consequences of a problem for further corrective action to be taken. From these consequences, several possible causes were sought. The causes of this problem also come from various sources, for example, work methods, materials, measurements, employees, the environment and so on<sup>[3]</sup>.

## 3. Result and discussion

### 3.1 OEE calculation

The calculation of the availability value uses equation (1). Availability reflects how much of the available working time is used in addition to that absorbed by down time losses. The company operates for 3 shifts per day, 8 hours per shift. For the percentage of the average availability ratio on the TWA 1342 machine is 95.12%. Where the highest percentage is at a value of 95.83% while the lowest value is 91.67%.

$$\text{Availability} = \frac{\text{Total Time Available} - \text{Down Time}}{\text{Total Time Available}}$$

For example on April 25, the calculation of the Availability value is:

$$\text{Total Time Available} = 1440 \text{ minute}$$

$$\text{Down Time} = 60 \text{ minute}$$

$$\text{Availability} = \frac{1440-60}{1440} \%$$

$$= 95.83 \%$$

Then the Availability value of the machine on April 25 is 95.83%.

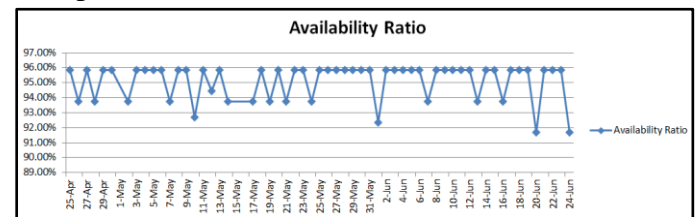


Figure 2. Availability Ratio TWA 1342 Machine

Calculation of performance value using equation (2) Analysis of Performance Ratio is a ratio of comparison of standard output with actual output on the TWA 1342 machine. The highest Performance value is reaching a value of 100% because the actual output reaches the target. While the lowest value is 66.67% because the output is not achieved. As for the Performance Ratio on the TWA 1342 machine is 85.06%.

$$\text{Performance} = \frac{\text{Number of units manufactured}}{\text{Possible number of unit manufactured}}$$

For example on April 25, the calculation of the Performance value is:

$$\text{Number of units manufactured}$$

$$= 14 \text{ lot}$$

$$\text{Possible number of unit manufactured}$$

$$= 15 \text{ lot}$$

$$\text{Performance}$$

$$= \frac{14}{15} \%$$

$$= 93.33 \%$$

Then the machine Performance value on April 25 is 93.33%.

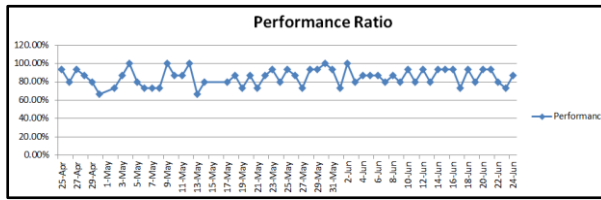


Figure 3. Performance Ratio TWA 1342 Machine

Calculation of the Quality Ratio value using equation (3) The quality value on the TWA 1342 machine is quite good, with the highest value being 99.67% and the lowest being 98.52%. As for the whole, the quality value of the TWA 1342 machine is 98.97%.

$$\text{Quality} = \frac{\text{Number of unit manufactured} - \text{Number of defect}}{\text{Number of unit manufactured}}$$

For example on April 25, the calculation of the Quality value is:

$$\begin{aligned} \text{Number of unit manufactured} &= 253.495 \text{ units} \\ \text{Number of defect} &= 1.746 \text{ units} \\ \text{Quality} &= \frac{253.495 - 1.746}{253.495} \% \end{aligned}$$

99.31 %

Then the value of the quality of the machine on April 25 is 99.31%.

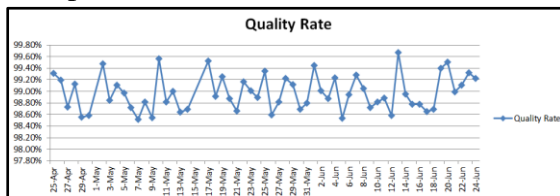


Figure 4. Quality Ratio TWA 1342 Machine

Calculation of OEE value using equation (4)

$$\text{OEE} = \text{Availability} \times \text{Performance} \times \text{Quality}$$

For example on April 25, the calculation of the OEE value is:

$$\begin{aligned} \text{Availability} &= 95.83\% \\ \text{Performance} &= 93.33\% \\ \text{Quality} &= 99.31\% \end{aligned}$$

$$\begin{aligned} \text{OEE} &= 95.83\% \times 93.33\% \times 99.31\% \\ &= 88.83\% \end{aligned}$$

Then the OEE value of the machine on April 25 is 88.83%.

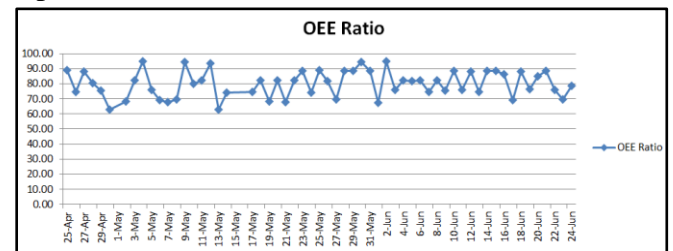


Figure 5. OEE Ratio TWA 1342 Machine

The analysis of the OEE value on the TWA 1342 machine can be seen in the following table.

Table 1. OEE Calculation on TWA 1342 Machine

Faktor OEE	Ideal Value	TWA 1342
Availability	>90%	95.12%
Performance	>95%	85.06%
Quality	>99%	98.97%
OEE	>85%	80.08%

### 3.2 Low output analysis

From The frequency of breakdown machine unit Data is the downtime that has the most effect on the effectiveness of production machines. The data used is the daily machine unit breakdown frequency data for April 25 – June 24, 2022 based on the Pareto chart below.

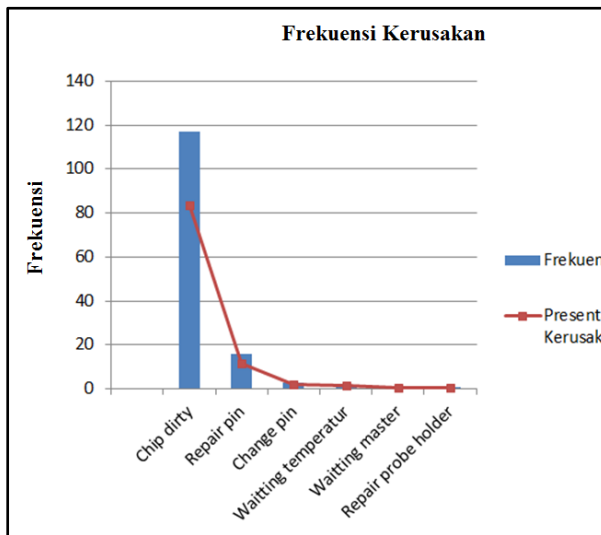


Figure 6. Machine Unit Breakdown Frequency

It can be seen that the most problems experienced were 83.57% dirty chips during the observation period. Based on data on the frequency of damage to the TWA 1342 machine, the problem of dirty chips is the biggest problem that hinders the achievement of the output target and does not achieve the OEE performance value of the TWA 1342 machine.

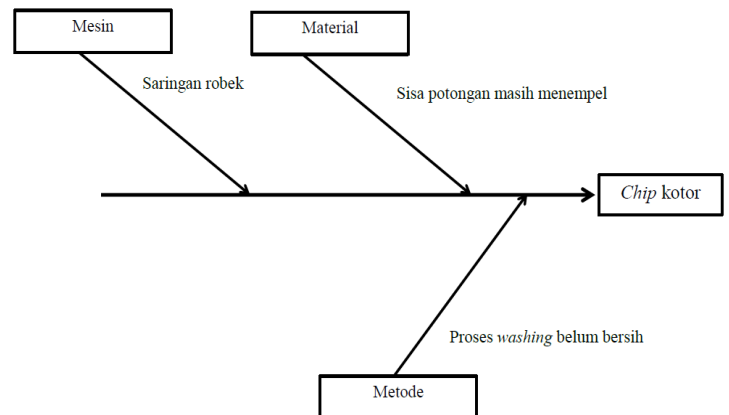
Then the analysis is carried out by direct observation to the field. The results of these observations may be the cause of the dirty chip problem, causing the TWA 1342 machine to not achieve output.

Figure 7. Fishbone Diagram Analysis Low Output

### Machine

The filter used for the washing process is not suitable for use, because there are tears on the surface of the filter so that the dirt is not filtered properly. Then the filter needs to be replaced periodically.

### Material



The remaining pieces are still attached to the foil so a visual check is needed to remove dirt from the remaining pieces.

### Method

The washing process that is not optimal causes the chip to be dirty, so it takes additional time to soak the material in the acetone so that the dirt that sticks out can be released.

Based on the type of problems obtained, to achieve the goal of increasing output by overcoming the problem of dirty chips, this needs to be repaired. Based on direct observation data to the field, it is known that the frequency of the causes of dirty chip problems can be seen in the diagram below.

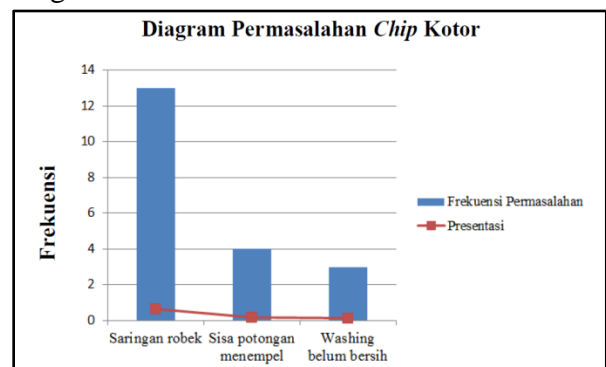


Figure 8. Root Cause Pareto Chart Chip Dirty

### 3.3 Increase output

To reduce the problem of dirty chips, continuous improvement efforts are needed so that output is achieved, here are the corrective steps taken to reduce these problems based on the diagram of the most dirty chip problems:

Filter is not worth to use	Change the filter regularly and control with the filter change record.
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Table 2. Action to Improve

Problem	Improvement
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Comparison of Availability values before and after improvement is carried out for a week in the period 25 July – 31 July 2022

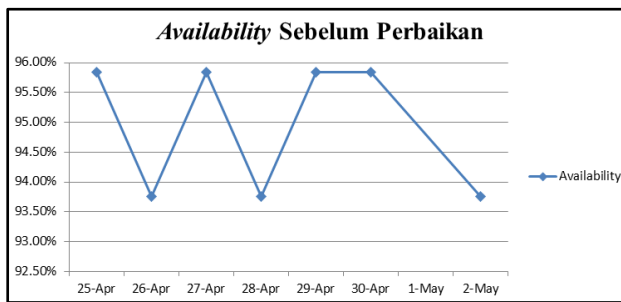


Figure 9. Availability Before

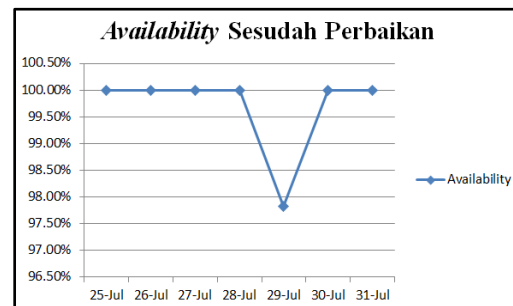


Figure 10. Availability After

Comparison of Performance values before and after improvement is carried out for a week in the period 25 July – 31 July 2022

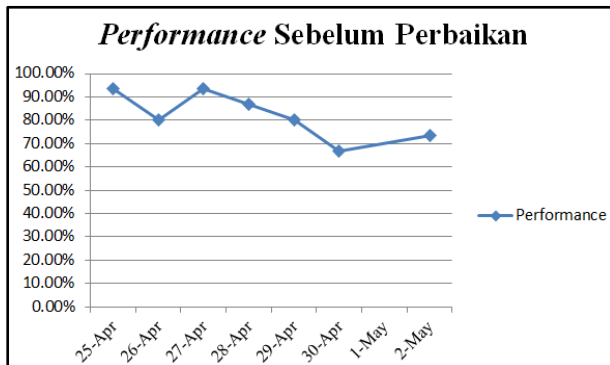


Figure 11. Performance Before

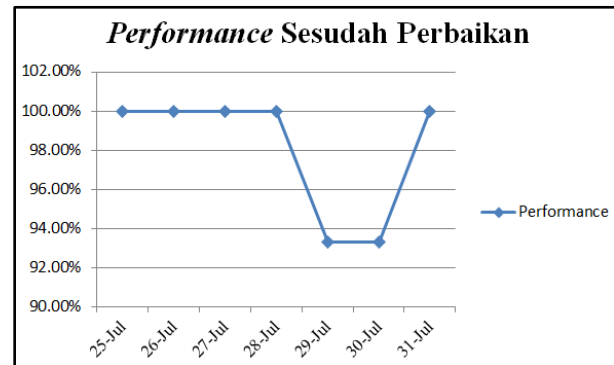


Figure 12. Performance After

Comparison of Quality values before and after improvement is carried out for a week in the period 25 July – 31 July 2022

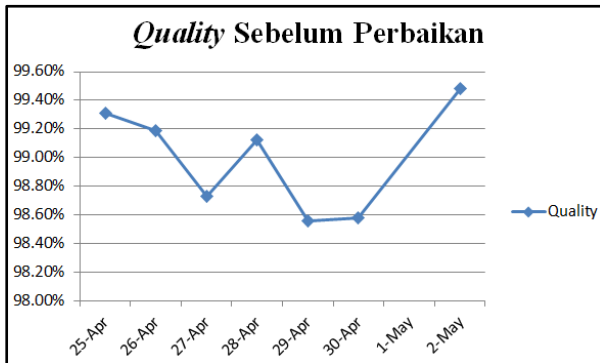


Figure 13. Quality Before

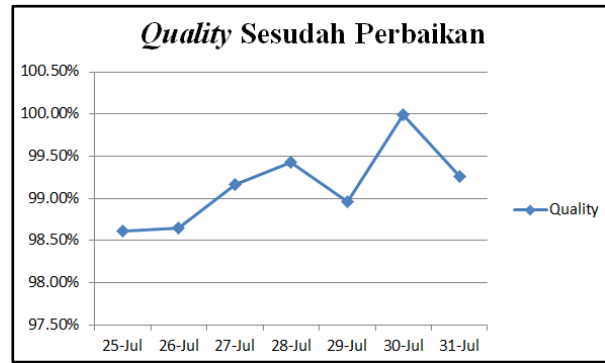


Figure 14. Quality After

Comparison of OEE values before and after improvement is carried out for a week in the period July 25 – July 31, 2022

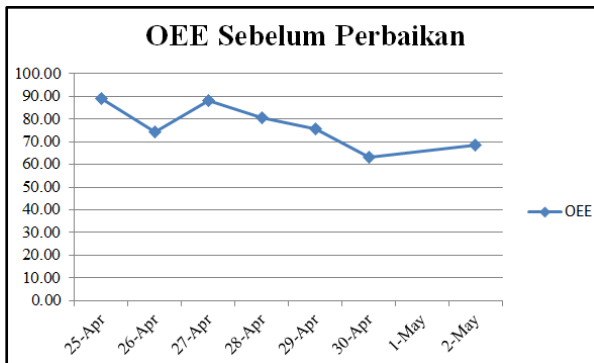


Figure 15. OEE Before

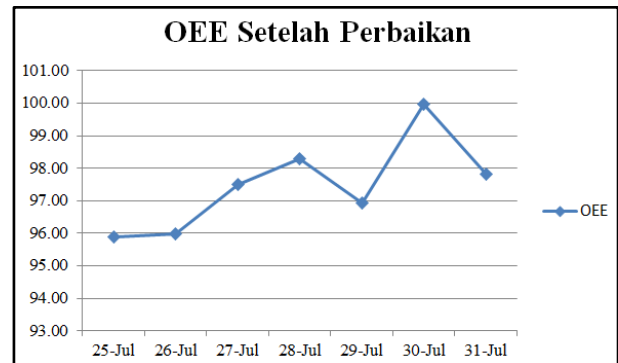


Figure 16. OEE After

As for the number of outputs, it can be seen from the picture below, on 29 and 30 July it was not achieved because there was downtime and there were still dirty chip problems. The number of outputs obtained after the corrective steps are carried out can be seen from the Pareto chart.

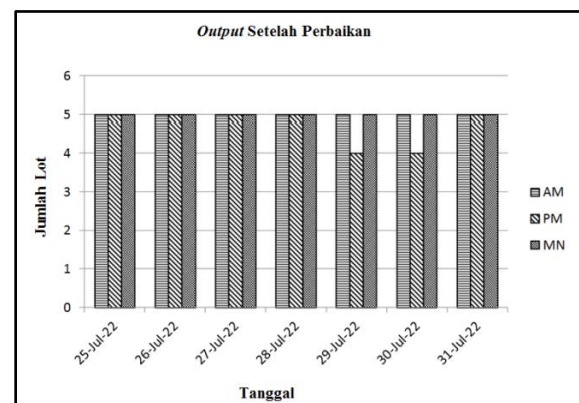


Figure 17. Output After Improvement

#### 4. Conclusion

From the results of data processing and analysis, the following conclusions can be drawn:

- 1). From the research period on the TWA 1342 machine that was carried out (25



April - 24 June 2022) the Availability value was 95.12%, the Performance value was 85.06%, the Quality value was 98.97%. And for the OEE value was 80.08%. The factor that is very influential on the low value of OEE is the low Performance Value, which is 85.06%.

- 2). The biggest cause of low output is due to dirty chip problems with a frequency percentage is 83.57%. As for the cause of the low output problem, the filter is not suitable for use because there are tears on the filter surface so that the dirt is not filtered properly.
- 3). Actions that can be taken to increase the output of the TWA 1342 machine are to replace the filter periodically and control it by having a filter change record.

This can be proven by the changes in the OEE value after the repair steps, changes to the TWA 1342 machine during a week of observation are as follows: Availability value 99.69%, Performance value 98.10%, Quality value 99.15%. And the OEE value is 96.96%. The percentage of the total output during the week of observation after corrective steps was taken is 98.10%. Where there is an increase in output of 13.04%.

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