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Calculation and Analysis of Overall Equipment Effectiveness (OEE) Method and Six Big Losses toward the Production of Corter Machines in Oni Jaya Motor

Widy Setyawan1 , Akhmad Sutoni1 , Taufik Munandar1 , and Mujiarto2

1Teknik Industri, Universitas Suryakencana, Cianjur, Indonesia
2Department of Mechanical Engineering, Universitas Muhammadiyah Tasikmalaya, Indonesia

Abstract

One of the factors that influence the smoothness in the Production Process is the condition of the equipment or machine. Frequent jams or even the engine may stop suddenly making the readiness and reliability of the machine is not optimal, causing production losses and quality degradation. For this reason, engine maintenance becomes a very important thing to consider in order to maintain the ongoing level of productivity. Oni Jaya Motor is a company engaged in manufacturing that produces motorcycle spare parts. This company is inseparable from problems related to the effectiveness of equipment or machinery. One of the causes of disruption to the production process is due to the lack of maintenance management on the machine. To overcome this, one of the methods used to measure engine effectiveness is the Overall Equipment Effectiveness (OEE) method. Where is known the value of OEE can provide information in evaluating maintenance activities so as to minimize the occurrence of lost production and decreased quality. The results of calculations with the OEE method on Oni Jaya motorcycles are carried out on the Corter Machine and take place from January 2018 to December 2018 with the highest OEE value of 81.0%, while the lowest OEE value of 77.1%. Based on the results of data processing and identification of the six big losses, the most influential losses on the machine are set up and adjustment of 29.8%, Reduced Speed Loss of 25.6% and Breakdown Loss of 21.3%. **(Approx. 241 words)**

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Oni Jaya Motor (OJM) is a company engaged in manufacturing by producing or modifying motorcycle parts. This company is inseparable from problems related to the effectiveness of equipment or machinery. One reason for the disruption of the production process is the lack of maintenance management on the machine. Oni Jaya Motor continues to strive to make continuous improvements to improve customer satisfaction. One of the continuous improvements that can be done at Oni Jaya Motor is product quality improvement by paying attention to the performance of the machine or equipment through improving the quality of maintenance.

Measurement of OEE (Overall Equipment Effectiveness) on the productivity and effectiveness of the machine or equipment is part of the activity to create customer satisfaction through improving machine or equipment maintenance

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2.1 According to Nakajima (1988) defines Total Productive Maintenance as an innovative approach to maintenance by optimizing the effectiveness of the equipment and reducing / eliminating breakdowns by first identifying. In other words, Total Productive Maintenance is often defined as productive maintenance carried out by all employees, based on the principle that improving the capability of equipment must involve everyone in the organization, from the lower layers to top management.

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Overall Equipment Effectiveness (OEE) is a hierarchical matrix discovered by Seiichi Nakajima in 1960 that can evaluate and indicate how effectively a manufacturing operation is utilized.

The results of this OEE are expressed in a general form that makes it easy to compare between manufacturing units in several different industries. Although OEE is not

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Maintenance managers will be required to improve maintenance standards and work efficiency while at the same time reducing operating costs. Budgets that are set up and determined frequently by non-technical managers require maintenance managers to operate within financial limits that are sometimes impossible to achieve with the type of workforce, skills and facilities available. Therefore we need a very good collaboration between various functions within the company and even more so among fellow field personnel / maintenance departments, to create an effective and efficient maintenance system.

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

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According to a source: www.oe.com/world-class-oe.html there are 4 ways to assess oee scores, i.e.

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- If OEE = 100%, production is considered perfect: only produce products without defects, work in fast performance, and no downtime.
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3. Results and Discussion

3.1. Overall Equipment Effectiveness Calculation Analysis(OEE)

Overall equipment effectiveness calculation analysis at Oni Jaya Motor is carried out to see the effectiveness level of the use of a cortical machine for 1 year. Measurement of Overall Equipment Effectiveness (OEE) is a multiplication of Availability, Performance Efficiency and Rate of Quality Products.

Tabel 1. Calculation of overall Equipment Effectiveness on Corter Machines from January December 2019

<i>Month</i>	<i>Availability (%)</i>	<i>Performance Efficiency (%)</i>	<i>Rate of Quality (%)</i>	<i>OEE (%)</i>
<i>January</i>	86,9	92,8	98,3	79,2
<i>February</i>	88,2	93,2	98,5	81,0
<i>March</i>	87,2	92,6	97,8	79,0
<i>April</i>	88,0	92,0	97,4	78,9
<i>May</i>	86,3	93,4	98,9	79,7
<i>June</i>	87,4	93,1	98,6	80,2
<i>July</i>	87,1	92,4	98,3	79,1
<i>August</i>	87,4	93,3	98,3	80,1
<i>September</i>	86,3	92,1	97,5	77,5
<i>October</i>	86,5	92,9	98,2	78,9
<i>November</i>	86,5	93,0	98,7	79,4
<i>December</i>	86,5	91,2	97,8	77,1

The results of data processing carried out in January - December 2018 at Oni Jaya Motor are as follows:

- During the period January - December 2018 obtained the Availability value around 86.3% - 88.2%. The value of Performance Efficiency is around 91.2% - 93.4%. The value of the Rate of Quality Products is around 97.4% - 98.9%. And the results of Overall Equipment Effectiveness (OEE) ranged from 77.1% - 81.0
- The highest OEE value is found in February 2018 at 81.0%. This OEE value is obtained from the Availability value of 88.2%, the Performance Efficiency value of 93.2% and the Rate of Quality Products value of 98.5%. While the lowest OEE value was found in December 2018 at 77.1%. This is due to the Availability value of 86.5%, the Performance Efficiency Value of 91.2% and the Rate of Quality Products value of 97.8%. Besides the factors causing the low OEE value in January - December 2018 is the amount of Equipment failure losses / Breakdown loss, Set up and adjustment losses and Reduced speed losses caused by the length of the engine breakdown time so that the engine work is not optimal.

3.2. Calculation of Time and Percentage of Six Big Losses

To see more clearly the six big losses that affect the effectiveness of the engine, the time loss calculation for each of the factors in the six big losses will be calculated as shown in the calculation results in the following table:

Tabel 2. Calculation Time and Percentage of Six Big Losses

No	Six Big Losses	Total Time Loss (hour)	Percentage (%)
1	Breakdown Loss	108,2	23,4
2	Set up and Adjustment Loss	132,9	28,7
3	Reduced Speed Loss	110,3	23,8
4	Idling Minor Stoppage	78,4	16,9
5	Rework Loss	33,5	7,2
6	Scrap or Yield Loss	0,0	0,0
<i>Total</i>		463,3	100

3.3. Calculation analysis of OEE six big losses

After the OEE value is obtained then the OEE six big losses is calculated. All data related to OEE six big losses are processed and produce the following OEE six big losses values :

- Breakdown Losses in January - December 2018 amounted to 4.1% - 5.3%. The value of Set up / Adjustment Losses in January - December 2018 is 5.3% - 6.4%
- 2. Idling and Minor Stoppage Losses value in January - December 2018 is 3.5%.
- 2. Reduce Speed Losses value in January - December 2018 is 4.65% - 5.87%.
- Reduce Speed Losses value in January - December 2018 is 4.65% - 5.87%
- The value of Reduced Yield Losses / scrap in January - December 2018 is 0%.

From the analysis above it can be seen that the Idling and Minor Stoppage Losses factor in OEE six big losses is the factor that gives the biggest contribution in OEE with an average percentage of 26.92%.

Table 3. Percentage of Six Losses for the Corter Machine

Cumulative Percentage Table influences six big losses		
No	Six Big Losses	Cumulative Percentge(%) CorterMachine
1	Set up and adjustnen Loss	28,7
2	Reduced Speed Loss	52,5
3	Break down Loss	75,9
4	Idle Minor Stopage	92,8
5	Rework Loss	100,0
6	Scrap or Yield Loss	100,0

3. Conclusion

Based on the analysis and description of the OEE measurement results, several conclusions can be drawn, namely:

- OEE value for the Korter machine, the calculation of which starts from January 2018 to December 2018, the highest percentage is 83.2% and the lowest is 79.1%.

- Factors that have the largest percentage of the Six Big Losses factor are Set Up And Adjustment of 29.8%, Reduced Speed Losses by 25.6%, Breakdown Loss of 21.3%, Idling Minor Stoppage of 14.9%, Rework Loss of 8.3%, and Scrap or Yield Loss of 0%.
- A good way to reduce or eliminate the six big losses that most influences the production process is by making a plan for equipment / machine maintenance using a predictive maintenance approach, providing training around the maintenance of production machine tools and setting-up of production machine tools effective for employees, as well as implementing improvements to machine tooling equipment.

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December	86,5	91,2	97,8	77,1

The results of data processing carried out in January - December 2018 at Oni Jaya Motor are as follows:

- During the period January - December 2018 obtained the Availability value around 86.3% - 88.2%. The value of Performance Efficiency is around 91.2% - 93.4%. The value of the Rate of Quality Products is around 97.4% - 98.9%. And the results of Overall Equipment Effectiveness (OEE) ranged from 77.1% - 81.0
- The highest OEE value is found in February 2018 at 81.0%. This OEE value is obtained from the Availability value of 88.2%, the Performance Efficiency value of 93.2% and the Rate of Quality Products value of 98.5%. While the lowest OEE value was found in December 2018 at 77.1%. This is due to the Availability value of 86.5%, the Performance Efficiency Value of 91.2% and the Rate of Quality Products value of 97.8%. Besides the factors causing the low OEE value in January - December 2018 is the amount of Equipment failure losses / Breakdown loss, Set up and adjustment losses and Reduced speed losses caused by the length of the engine breakdown time so that the engine work is not optimal.

3.2. Calculation of Time and Percentage of Six Big Losess

To see more clearly the six big losses that affect the effectiveness of the engine, the time loss calculation for each of the factors in the six big losses will be calculated as shown in the calculation results in the following table:

Tabel 2. Calculation Time and Percentage of Six Big Losess

No	Six Big Losses	Total Time Loss (hour)	Percentage (%)
1	Breakdown Loss	108,2	23,4
2	Set up and Adjustment Loss	132,9	28,7
3	Reduced Speed Loss	110,3	23,8
4	Idling Minor Stoppage	78,4	16,9
5	Rework Loss	33,5	7,2
6	Scrap or Yield Loss	0,0	0,0
<i>Total</i>		463,3	100

3.3. Calculation analysis of OEE six big losses

After the OEE value is obtained then the OEE six big losses is calculated. All data related to OEE six big losses are processed and produce the following OEE six big losses values :

- Breakdown Losses in January - December 2018 amounted to 4.1% - 5.3%. The value of Set up / Adjustment Losses in January - December 2018 is 5.3% - 6.4%
- 2. Idling and Minor Stoppage Losses value in January - December 2018 is 3.5%.
- 2. Reduce Speed Losses value in January - December 2018 is 4.65% - 5.87%.
- Reduce Speed Losses value in January - December 2018 is 4.65% - 5.87%
- The value of Reduced Yield Losses / scrap in January - December 2018 is 0%.

From the analysis above it can be seen that the Idling and Minor Stoppage Losses factor in OEE six big losses is the factor that gives the biggest contribution in OEE with an average percentage of 26.92%.

Table 3. Percentage of Six Losses for the Corter Machine

Cumulative Percentage Table influences six big losses

No	Six Big Losses	Cumulative Percentge(%) CorterMachine
1	Set up and adjustnen Loss	28,7
2	Reduced Speed Loss	52,5
3	Break down Loss	75,9
4	Idle Minor Stopage	92,8
5	Rework Loss	100,0
6	Scrap or Yield Loss	100,0

3. Conclusion

Based on the analysis and description of the OEE measurement results, several conclusions can be drawn, namely:

- OEE value for the Korter machine, the calculation of which starts from January 2018 to December 2018, the highest percentage is 83.2% and the lowest is 79.1%.

- Factors that have the largest percentage of the Six Big Losses factor are Set Up And Adjustment of 29.8%, Reduced Speed Losses by 25.6%, Breakdown Loss of 21.3%, Idling Minor Stoppage of 14.9%, Rework Loss of 8.3%, and Scrap or Yield Loss of 0%.
- A good way to reduce or eliminate the six big losses that most influences the production process is by making a plan for equipment / machine maintenance using a predictive maintenance approach, providing training around the maintenance of production machine tools and setting-up of production machine tools effective for employees, as well as implementing improvements to machine tooling equipment.

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Calculation and Analysis of Overall Equipment Effectiveness (OEE) Method and Six Big Losses toward the Production of Corter Machines in Oni Jaya Motor

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Abstract. One of the factors that influence the smoothness in the Production Process is the condition of the equipment or machine. Frequent jams or even the engine may stop suddenly making the readiness and reliability of the machine is not optimal, causing production losses and quality degradation. For this reason, engine maintenance becomes a very important thing to consider in order to maintain the ongoing level of productivity. Oni Jaya Motor is a company engaged in manufacturing that produces motorcycle spare parts. This company is inseparable from problems related to the effectiveness of equipment or machinery. One of the causes of disruption to the production process is due to the lack of maintenance management on the machine. To overcome this, one of the methods used to measure engine effectiveness is the Overall Equipment Effectiveness (OEE) method. Where is known the value of OEE can provide information in evaluating maintenance activities so as to minimize the occurrence of lost production and decreased quality. The results of calculations with the OEE method on Oni Jaya motorcycles are carried out on the Corter Machine and take place from January 2018 to December 2018 with the highest OEE value of 81.0%, while the lowest OEE value of 77.1%. Based on the results of data processing and identification of the six big losses, the most influential losses on the machine are set up and adjustment of 29.8%, Reduced Speed Loss of 25.6% and Breakdown Loss of 21.3%.

1. Introduction

A process on the production floor is often disrupted due to a problem in the production machine or equipment. These problems such as the machine stops suddenly, decreases the speed of production and the machine produces defective products and others. This will cause losses to the company because in addition to reducing the level of efficiency and effectiveness of the machine or equipment, it also results in costs incurred due to the damage.

Oni Jaya Motor (OJM) is a company engaged in manufacturing by producing or modifying motorcycle parts. This company is inseparable from problems related to the effectiveness of equipment or machinery. One reason for the disruption of the production process is the lack of maintenance management on the machine. Oni Jaya Motor continues to strive to make continuous improvements to improve customer satisfaction. One of the continuous improvements that can be done at Oni Jaya Motor is product quality improvement by paying attention to the performance of the machine or equipment through improving the quality of maintenance.



Measurement of OEE (Overall Equipment Effectiveness) on the productivity and effectiveness of the machine or equipment is part of the activity to create customer satisfaction through improving machine or equipment maintenance

2. Methods

2.1 According to Nakajima (1988) defines Total Productive Maintenance as an innovative approach to maintenance by optimizing the effectiveness of the equipment and reducing / eliminating breakdowns by first identifying. In other words, Total Productive Maintenance is often defined as productive maintenance carried out by all employees, based on the principle that improving the capability of equipment must involve everyone in the organization, from the lower layers to top management.

2.2 Availability, Performance, Quality

2.2.1 Availability

Availability, namely the willingness or readiness of the machine to operate. This value is a parameter of the success of engine maintenance activities (η). Standards for indexes for willingness or readiness. There are two parameters that affect the availability value

$$\text{Availability} = \frac{\text{Loading time} - \text{Down Time}}{\text{Loading time}} \times 100\%.$$

2.2.2 Performance

Performance is the result of the multiplication of the operation speed and net operation rate, or the ratio of the quantity of products produced is multiplied by the ideal cycle time to the time available in the production process (operation time). Operation speed rate is a comparison between ideal engine speeds based on actual engine capacity

$$\text{Performance} = \frac{\text{Output} \times \text{Cycle time optimal}}{\text{Operation time}} \times 100\%$$

2.2.3 Quality

The rate of quality product is the ratio of the number of good products to the total number of products processed. So the rate of quality of the product

$$\text{Quality} = \frac{\text{Output} - \text{Reduced yield} - \text{Reject}}{\text{Output}} \times 100\%$$

2.3 Overall Equipment Effectiveness (OEE)

Overall Equipment Effectiveness (OEE) is a hierarchical matrix discovered by Seiichi Nakajima in 1960 that can evaluate and indicate how effectively a manufacturing operation is utilized.

The results of this OEE are expressed in a general form that makes it easy to compare between manufacturing units in several different industries. Although OEE is not

is a measurement that can produce absolute data, OEE is the best technique for identifying the scope of improvement in the performance of the process and directing how to achieve improvement. For example, if cycle time has been reduced, OEE can also reduce even though more products are produced from fewer sources.

Maintenance managers will be required to improve maintenance standards and work efficiency while at the same time reducing operating costs. Budgets that are set up and determined frequently by non-technical managers require maintenance managers to operate within financial limits that are sometimes impossible to achieve with the type of workforce, skills and facilities available. Therefore we need a very good collaboration between various functions within the company and even more so among fellow field personnel / maintenance departments, to create an effective and efficient maintenance system.

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

2.4 How to Assess Overall Equipment Effectiveness (OEE) Score

According to a source: www.oe.com/world-class-oe.html there are 4 ways to assess oee scores, i.e.

:

- If OEE = 100%, production is considered perfect: only produce products without defects, work in fast performance, and no downtime.
- If OEE = 85% - 99%, production is considered world class. For many companies, this score is a score that is suitable for long-term goals.
- If OEE = 60% - 84%, production is considered reasonable, but shows a large room for improvement.
- If OEE = <60%, production is considered to have a low score, but in most cases it can be easily improved through direct measurement

3. Results and Discussion

3.1. Overall Equipment Effectiveness Calculation Analysis(OEE)

Overall equipment effectiveness calculation analysis at Oni Jaya Motor is carried out to see the effectiveness level of the use of a cortical machine for 1 year. Measurement of Overall Equipment Effectiveness (OEE) is a multiplication of Availability, Performance Efficiency and Rate of Quality Products.

Table 1. Calculation of overall Equipment Effectiveness on Corter Machines from January December 2019

Month	Availability (%)	Performance Efficiency (%)	Rate of Quality (%)	OEE (%)
January	86,9	92,8	98,3	79,2
February	88,2	93,2	98,5	81,0
March	87,2	92,6	97,8	79,0
April	88,0	92,0	97,4	78,9
May	86,3	93,4	98,9	79,7
June	87,4	93,1	98,6	80,2
July	87,1	92,4	98,3	79,1
August	87,4	93,3	98,3	80,1
September	86,3	92,1	97,5	77,5
October	86,5	92,9	98,2	78,9
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December	86,5	91,2	97,8	77,1

The results of data processing carried out in January - December 2018 at Oni Jaya Motor are as follows:

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