



Analysis and Suggestions for Improvement of Marubeni Engine Performance at Pt. Indonesian Nuclear Industry (Persero) with Overall Equipment Effectiveness (OEE) Approach

Aris Munandar

Industrial Engineering Study Program, Indonesian Institute of Technology Serpong, Indonesia

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ABSTRACT

The occurrence of downtime can cause the production process to stop and cause the resulting product to not match the specified quality. Therefore, downtime prevention must be carried out by conducting research to determine the effectiveness of the machine using the approach used in increasing the effectiveness of the machine is Total Productive Maintenance (TPM). Meanwhile, OEE (Overall Equipment Effectiveness) is a method used as a measurement in implementing the TPM program, in order to keep the equipment in ideal conditions by analyzing the Six Big Losses of the equipment. Based on the results of the calculation of the Rate of Quality of 72.92%, the value of the rate of quality product is still below the JIPM standard, namely 99%, because the quality level is not close to the standard number, which means that the number of reject products must be suppressed again, supported by the results. which is obtained from the Defect Losses value of 24.01% and the Yield Losses value of 1.92. In order to obtain representative information for maintenance and continuous improvement (continuous improvement) in an effort to increase the effectiveness of machine use.

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Corresponding Author:

Aris Munandar
Industrial Engineering Study Program
Indonesian Institute of Technology Serpong
Jl. Puspitek, Setu, South Tangerang City, Banten, 15314, Indonesia
Email: aris@gmail.com

1. INTRODUCTION

An industry, whether small, medium, or large, is always faced with increasingly fierce competition, where every producer is vying to become a market leader in their efforts to gain the widest possible market. (Rahmawati, 2020). For an industry, being a leader is one of the important indicators in winning the competition (Suhaeni, 2018). However, in achieving this goal, producers are also required to produce quality products at the most efficient cost possible (Rahmawati, 2020). One thing that must be considered in order to create a quality product at an efficient cost (Anastasia & Nulow, 2014) possible then the company can perform maintenance (maintenance) production facilities (Arifianto, 2018). Maintenance of production facilities is an effort to maintain quality and increase productivity (Wiyatno, 2015). The production facilities here are in the form of machine components that must be maintained so that they are in the same condition as when they were new (Rahman, 2019), or at least be in a reasonable condition to perform the operation. The engine is the main component (dwi Hariyanto & Handayani, 2015) in the production process. In a

production, one machine with another machine is interconnected (Sudarso, 2022), if one of the machines is damaged, the production process will have an effect, the production target is reduced, the funds for repairing the damage are high and in the end the company suffers a loss. Determination of the machine to be repaired can be seen from the high downtime value (Santoso, 2017). Downtime is the amount of time that a component cannot function due to a failure. (Maulana et al., 2017). Damage that occurs to the machine will affect the work performance and efficiency of the machine (Hutahaean, 2018). PT Industri Nuklir Indonesia (Persero) or PT INDUSTRI NUKLIR INDONESIA (Persero) is the only BUMN in Indonesia that produces radioisotopes and radiopharmaceuticals. (Munandar, 2020). Therefore, BECOME A REGIONAL AND INTERNATIONAL RADIOISOTOP AND RADIOpharmaceutical MANUFACTURER is one of the biggest visions of PT INDUSTRI NUKLIR INDONESIA (PERSERO) (STRATEGY & COUNTRY, nd). Based on historical data from January 2018 to December 2018 obtained from maintenance (Hari & Iriani, 2020), "Marubeni" type Vertical Boring Mills lathe at PT. The Indonesian Nuclear Industry (Persero) is a machine that has a fairly high downtime rate of 1,409 minutes (Source: Maintenance Division of PT. Industri Nuklir Indonesia (PERSERO) and an OEE rate of 83.10% (Source: OEE in the last year at PT. INDONESIA NUCLEAR INDUSTRY PERSERO) as a whole for the resulting OEE value has a value below the standard according to World Class OEE (Source: <http://www.oee.com/world-class-oee.html>). Because this Marubeni lathe is for turning workpieces with solid materials such as iron and steel, where the majority of orders obtained by PT INDUSTRI NUKLIR INDONESIA PERSERO are LPF 8, Cover LPF 8 (WJ802TELB), HPF 1500 L (WJ787TELB), Plug Screw (WJ836WISB) so that this Marubeni lathe is the main machine and is very reliable.

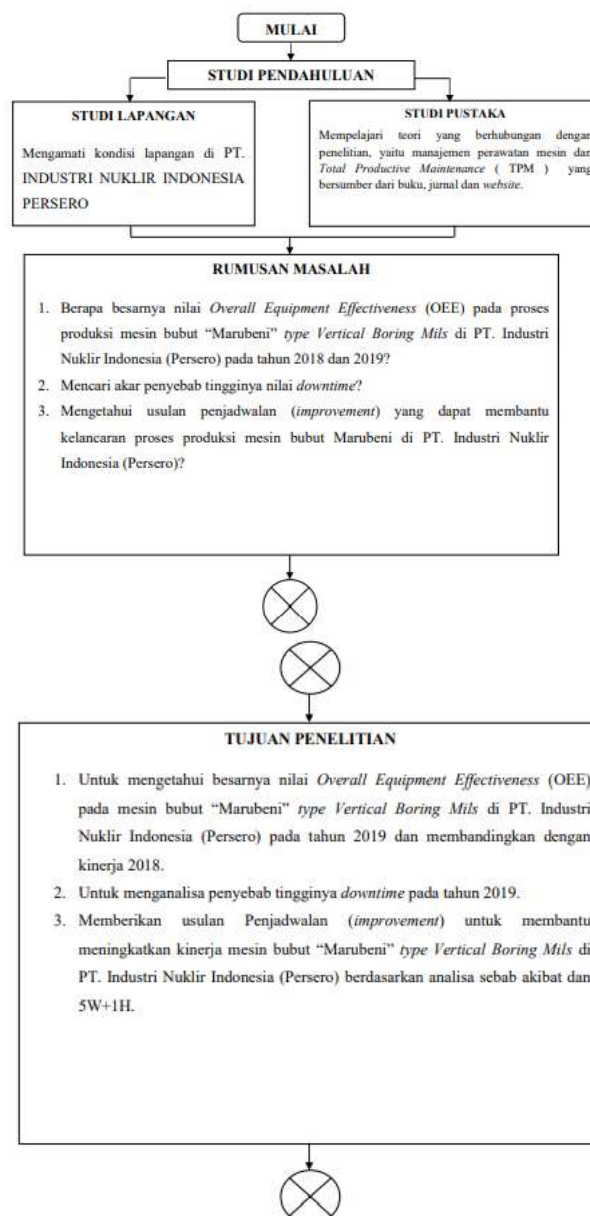
While the machine maintenance steps carried out by the company so far are in the form of corrective maintenance or the machine will be repaired if there is damage and there is no special and periodic machine maintenance schedule. (Permatasari, 2018). Therefore, a new maintenance schedule was proposed for the Marubeni lathe. By knowing the critical components that exist on the Marubeni lathe, it can be easier to determine the maintenance schedule on the Marubeni lathe. If the maintenance is carried out, it can minimize the total cost of maintenance and repair of production facilities so that they can work as expected. From the problems that exist in PT. INDONESIA NUCLEAR INDUSTRY PERSERO (Henri, 2013), Overall Equipment Effectiveness (OEE) is one approach to determine the level of effectiveness of equipment utilization. OEE is known as one of the application programs of Total Productive Maintenance (TPM). With this Overall Equipment Effectiveness (OEE) calculation (Novrisal & Yosana, nd), is a method that can determine the value of machine productivity and cover all sides of the production line, especially on production machines. OEE is closely related to the availability ratio, performance ratio, and quality ratio of the production process (Nugroho, 2010). Total Productive Maintenance (TPM) is a good method to make it happen. This is because this method involves all personnel in the company and also aims to maintain all production facilities owned by the company (Susilo, 2021). Total Productive Maintenance (TPM) itself is a method developed by Japan to support maintenance performance which is a concept and method that will maximize equipment effectiveness, eliminate breakdowns, with the involvement of the operator as autonomous maintenance along with other employees and management, in day-to-day operations. day activities within a company. Total Productive Maintenance (TPM) is often referred to as productive maintenance with an additional total participation. This total participation means that operators who were previously considered only in charge of using equipment or machines to operate, in this maintenance system the operators are involved as part of maintenance management.

Based on this background, the authors propose "ANALYSIS AND PROPOSED PERFORMANCE IMPROVEMENTS OF MARUBENI MACHINERY AT PT. INDONESIA NUCLEAR INDUSTRY (PERSERO) WITH OERALL EQUIPMENT EFFECTIVENESS (OEE) APPROACH". With this study aims to provide input or suggestions to the problems faced at PT. INDONESIA NUCLEAR INDUSTRY (PERSERO). By going through this OEE calculation, it may be able to help solve the root causes of the problems encountered and in the future can help improve the machine production process at PT. INDONESIA NUCLEAR INDUSTRY (PERSERO).

The objectives of carrying out this practical work activity are as follows: (1) To determine the value of Overall Equipment Effectiveness (OEE) on the "Marubeni" Vertical Boring Mills lathe at PT. The Indonesian Nuclear Industry (Persero) in 2019 and compared with 2018 performance. (2) To analyze the causes of high downtime in 2019. (3) Provide a Scheduling proposal (improvement) to help improve the performance of the "Marubeni" Vertical Boring Mills lathe in PT. Indonesian Nuclear Industry (Persero) based on causal analysis and 5W+1H.

2. RESEARCH METHOD

2.1 Research Steps (Flow Chart)



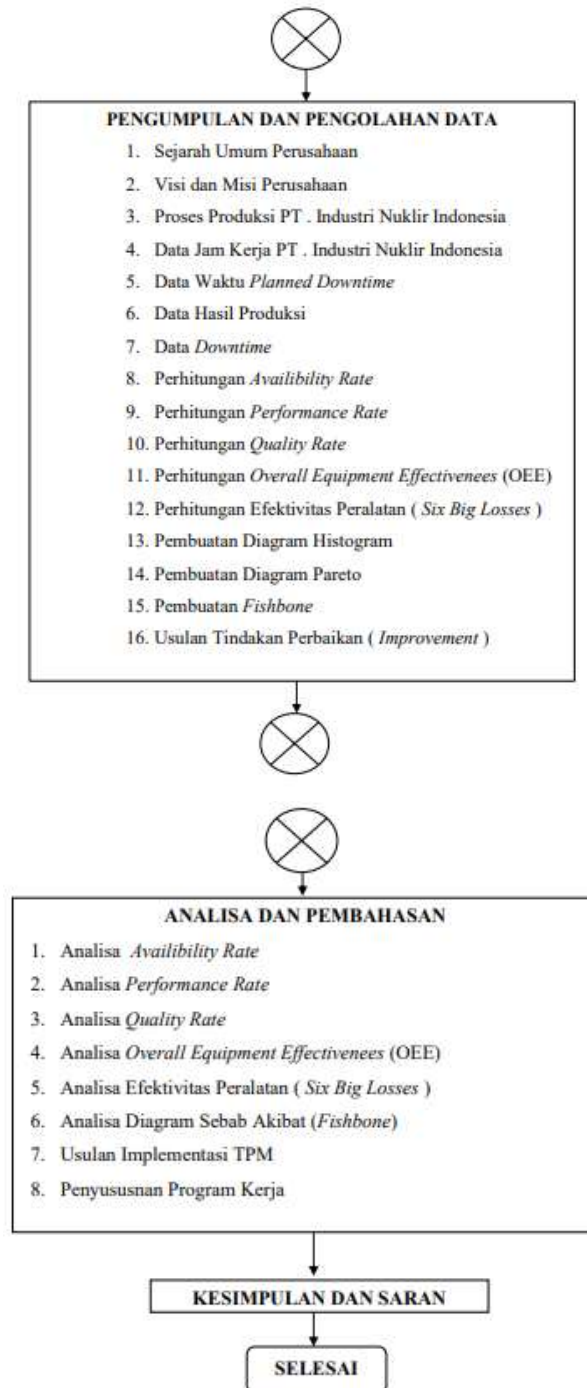


Figure 1. Flow Chart (Flow Chart) Research Methodology (Continued)

3. RESULTS AND DISCUSSIONS

3.1. Data processing

3.1.1 Stainless Steel Without TIG Welding (Test Object I)

After all the data is collected, then the data processing is carried out

Table 1. Calculation of Loading Time in January 2019 – December 2019

Bulan	Available Time (menit)	Planned Downtime (menit)	Loading Time (menit)
Januari	14640	1125	13515
Februari	15120	1035	14085
Maret	15360	1302	14058
April	16320	1435	14885
Mei	14400	1391	13009
Juni	15120	1437	13683
Juli	14160	1429	12731
Agustus	14880	1252	13628
September	15600	1463	14137
Oktober	15360	1187	14173
November	15120	1167	13953
Desember	15840	1150	14690

Table 2. Calculation of Total Downtime in January 2019 – December 2019

Bulan	Planned Downtime (menit)	Breakdown Time (menit)	Total Downtime (menit)
Januari	1125	90	1215
Februari	1035	180	1215
Maret	1302	120	1422
April	1435	60	1495
Mei	1391	120	1511
Juni	1437	60	1497
Juli	1429	180	1609
Agustus	1252	60	1312
September	1463	120	1583
Oktober	1187	120	1307
November	1167	60	1227
Desember	1150	360	1510

Table 3. Calculation of Overall Equipment Effectiveness (OEE) in January 2019 – December 2019

Bulan	Availability Rate	Performance Rate	Rate of Quality	OEE	JIPM
Januari	91,01%	99,02%	75%	67,59%	85%
Februari	91,37%	99,11%	75%	67,92%	85%
Maret	89,88%	98,73%	75%	66,56%	85%
April	89,96%	98,75%	75%	66,63%	85%
Mei	88,38%	98,27%	75%	65,14%	85%
Juni	89,06%	98,49%	75%	65,79%	85%
Juli	87,36%	97,91%	75%	64,15%	85%
Agustus	90,37%	98,87%	75%	67,01%	85%
September	88,80%	98,41%	75%	65,54%	85%
Oktober	90,78%	98,97%	75%	67,38%	85%
November	91,21%	99,07%	75%	67,77%	85%
Desember	89,72%	98,69%	50%	44,27%	85%
Rata - rata				64,65%	

Based on Table 4.16 it is known that the value of Overall Equipment Effectiveness (OEE) is below the standard JIPM value of 64.65%. From this value, it is known that the effectiveness of the "Marubeni" Type Vertical Boring Mills lathe as a whole still requires evaluation for improvements to be made in an effort to increase the effectiveness of the "Marubeni" Type Vertical Boring Mills lathe.

3.1.2 Calculation of Six Big Losses

The calculation of the value of Six Big Losses is carried out to determine the scattered losses that affect the effectiveness of the "Marubeni" Type Vertical Boring Mills lathe. Six Big Losses are classified into 3 groups, as follows: (1) Equipment Failures (Breakdowns), Equipment Failures are losses caused by damage to machines or equipment. Damage to the machine is the cause of the obvious loss, because such damage will result in the machine not producing output. The percentage of the effectiveness of the machine that is lost due to factors breakdowns losses can be calculated using the following formula:

$$Breakdown Losses = \frac{Breakdowntime}{Loading Time} \times 100\% \tag{1}$$

By using the above formula, the calculation of breakdown losses in January is obtained as follows:

$$Breakdown Losses = \frac{90}{13515} \times 100\% = 0,67\%$$

With the same calculation method, the percentage of breakdown losses for the "Marubeni" Lathe Type Vertical Boring Mills January 2019 - December 2019 can be seen in Table 4.17.

Table 4. Calculation of Breakdowns Losses in January 2019 – December 2019

Bulan	Breakdown Time (menit)	Loading Time (menit)	Breakdown Losses
Januari	90	13515	0,67%
Februari	180	14085	1,28%
Maret	120	14058	0,85%
April	60	14885	0,40%
Mei	120	13009	0,92%
Juni	60	13683	0,44%
Juli	180	12731	1,41%
Agustus	60	13628	0,44%
September	120	14137	0,85%
Oktober	120	14173	0,85%
November	60	13953	0,43%
Desember	360	14690	2,45%
Rata - Rata	128	13879	0,92%

3.2. Analysis

Based on the data processing that has been done, this section will discuss further about the analysis of the processing results, in order to know the current performance of the company using the Overall Equipment Effectiveness (OEE) method and what strategies can be carried out or applied to the PT Industri company. Nuklir Indonesia (Persero) to increase the company's competitiveness.

3.2.1 Analysis of Overall Equipment Effectiveness

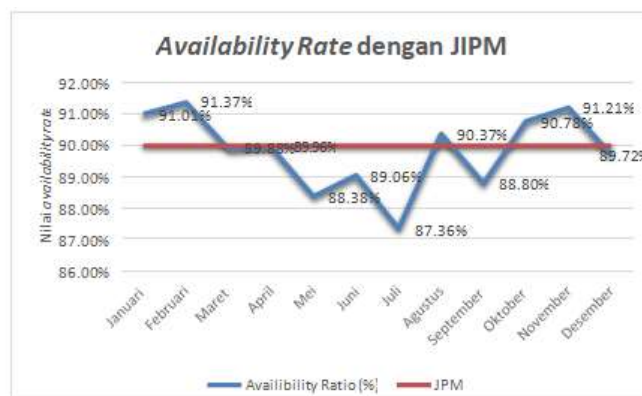


Figure 2. Graph of Comparison of Availability Rate Value with JIPM.

Based on Figure 5.1, it can be seen that the availability rate value during the period January 2019 to December 2019 has increased and decreased when compared to the JIPM value. There are 7 months of availability rate values that are below the standard value of JIPM, namely: March (89.88%), April (89.96%), May (88.38%), June (89.06%) , July (87.36%), September 88.80%), and December (89.72%). This indicates that there is still a large amount of time needed when downtime

occurs on the "Marubeni" type vertical boring mills lathe. There are 5 months of availability rate values that are below the JIPM standard value, namely: January (91.01%), February (91.37%), August 2019 (90.37%), October 2019 (90.78%), and November 2019 (91,

3.2.2 Analysis of Six Big Losses

Six Big Losses analysis is made so that the company knows what factors from the six six big losses factors make the biggest contribution that results in the low effectiveness of using the "Marubeni" type vertical boring mills lathe.

Table 5. Percentage Factor Six Big Losses Lathe

No	Six Big Losses	Total Time Losses (minutes)	Percentage	Cumulative Presentation
1	Breakdown Losses	127,500	4.24%	4.24%
2	Setup and Adjustment Losses	1281,083	42.62%	46.86%
3	Idling and Minor Stoppages	1.083	0.04%	46.90%
4	Reduced Speed	1570,279	52.24%	99.14%
5	Defect Losses	24.008	0.80%	99.94%
6	Yield Losses	1,920	0.06%	100.00%
	Total	3006	100%	

Table 6. Percentage of Actual Working Hours per Year Lathe

Total Actual Hours Per Year (minutes)	Losses (minute)
<i>Loading Time</i>	13878,917
<i>Operating Time</i>	12470,333
<i>Net Operating Time</i>	12308,638
<i>Valuable Operating Time</i>	8960,499

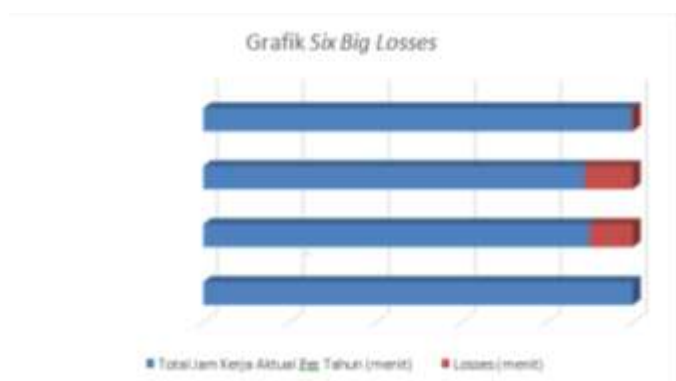


Figure 3. Graph of corrosion rate of stainless steel 304 in HNO₃ solution with pH 0.2

3.3. Discussion

In making the preventive maintenance model for the Preventive Maintenance Control (PMC) lathe "Marubeni" type vertical boring mills, it must be based on data on the location of the machine or the location of the machine. The machines recorded in this study are located in the machine workshop (machining workshop). In the data collection, it is necessary to note the location of the machine, the name of the machine, the type of machine, the main components, component parts, maintenance actions, duration of maintenance, maintenance personnel, tools, materials, controls and information.

Implementation of maintenance is made based on preventive maintenance actions, namely, inspections such as checking the condition of the gearbox. Cleaning, such as cleaning dirty or dusty engine components using diesel fuel and brushes, including cleaning the engine body,

cleaning the engine skating mat. Lubrication is like lubricating gears with oil, lubricating bearings with grease.

Locks such as locking loose bolts or nuts include locking machine foundation bolts, locking bolts on the rotary handle. Adjustments such as adjusting the loose head in line with the loose head bearing line, adjusting the tension of the engine pulley so that the v-belt does not loosen. Replacement is like changing the lubricating oil in the gearbox.

The preventive maintenance schedule is carried out routinely or every day such as locking and adjusting the main components of the blade. Periodic maintenance is carried out once a week such as lubricating and cleaning the main components of the engine body.

And once a year such as checking electrical circuits, motors, shafts, gearboxes, spindles, changing oil and wheel pulleys. by scheduling maintenance, the maintenance of each machine will be controlled, so that the schedule made must be continuous, so the maintenance time is carried out on one main component for one day of maintenance.

Officers in preventive maintenance of production machine tools are divided into two parts, namely; The operator is on duty after the machine is used, the machine is immediately cleaned by locking and adjusting the main components of the blade. Regular maintenance is carried out once a week such as lubricating and cleaning the main components of the engine body. Experts in preventive maintenance of machine tools work on difficult parts such as electrical circuits, motors, shafts, gearboxes, spindles, changing oil and wheel pulleys.

The equipment used in carrying out preventive maintenance on this machine tool is a brush that serves to clean the machine parts that are difficult to reach or irregular surfaces, such as cleaning gears, cleaning bram that is scattered on the machine body or reservoir. The function of the rag is to clean easily accessible parts or flatter surfaces, such as cleaning the engine body from dirt and dust, cleaning the slides that are not covered so that the delicate brams are removed from the slide mat.

Wrench and L key are used to lock loose bolts or nuts on machine components, use wrenches such as locking bolts on machine foundations, locking bolts on machine tables and use of L keys such as locking bolts on handles, locking bolts on peg blade bases.

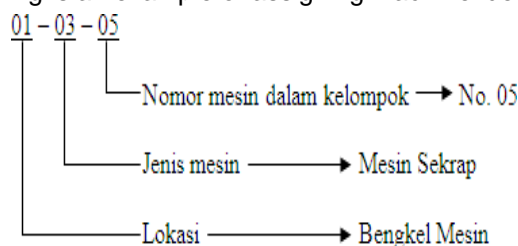
Materials used in preventive maintenance include: Solar which functions to clean engine components from lubricants that are no longer suitable for use, this is because diesel is easy to lift sticking lubricants such as cleaning the screw shaft from gums, cleaning table slides for table drilling machines.

Lubricating oil is a liquid lubricant that melts easily, the oil used is SAE 140 (society automotive engineering with a viscosity of 140) which is suitable for use in gear boxes and heavy-duty shafts. Control is carried out to find out whether or not maintenance is carried out on the schedule that has been made. For example, if (there is) implemented, the officer puts a check mark on the control table exists and if it is not implemented then the officer puts a check mark on the control table (not) is implemented. The explanation is done to find out the reason if the control is not carried out such as changing the lubricating oil, because the machine tools are not operated often and the oil is still good.

4. CONCLUSION

Based on the results of research and data processing and analysis that has been carried out on the "Marubeni" type vertical boring mills lathe at PT.Industri Nuklir Indonesia (PERSERO) it can be concluded as follows: (1) From the results of the OEE (Overall Equipment Effectiveness) calculation that has been carried out, the average OEE value is 64.65%, the OEE value for the period January-December 2019 is below the ideal OEE standard, which is 85% (Japan Institute of Plant Maintenance). From the average value, it can be seen that the effectiveness of the "Marubeni" type vertical boring mills lathe as a whole is not optimal, so it can reduce the production process. (2) Based on the results of the calculation of Speed Losses of 52,28% that the value of the rate of quality product is still below the JIPM standard, which is 99%, because the quality level is not close to the standard number, which means that the number of reject products must be re-

pressed, also supported by the results obtained from the Idling and Minor Stoppage values of 0.04% and the value of Reduce Speed of 52.24%. (3) Recommendations for Improvements and Steps, Improvement Models are plans or descriptions that explain an object or concept in the form of simplification. Preventive maintenance of the Preventive Maintenance Control (PMC) system is maintenance carried out on machine components to get a controlled maintenance turn, by controlling the maintenance of machine tools, time intervals are determined in such a way that major damage can be avoided, to avoid such damage, maintenance work planning is needed. The following is an example of assigning machine identity.



And the steps are: (a) Inspection, (b) conceptual framework, (c) Recording Machine Component Identification, (d) Main component, (e) Component Part, (f) Treatment Implementation, (g) Discussion.

Suggestions Some suggestions that are expected to provide input and are useful for the company based on the results of this study are Performing the calculation of Overall Equipment Effectiveness (OEE) on every machine in the company always carried out, so that representative information is obtained for continuous maintenance and improvement (continuous improvement).) in an effort to increase the effectiveness of the use of machines. The use of the Overall Equipment Effectiveness (OEE) method is relatively easy and can be done by every operator. Conduct training for each operator and maintenance personnel. In order to improve the ability and expertise of operators in carrying out their work.

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