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Proposed Total Productive Maintenance (TPM) Implementation to Increase Heading Machine Effectiveness Using Overall Equipment Effectiveness (OEE) Method on PT. XYZ

Rupertus Mario Serapion Leke*, Joumil Aidil Saifuddin

Department of Industrial Engineering, Universitas Pembangunan Nasional "Veteran" Jawa Timur, Jl. Raya Rungkut Madya Gunung Anyar, Surabaya 60294 Indonesia

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A B S T R A C T

PT XYZ is one of the companies engaged in the precast concrete manufacturing industry which is specially designed to meet the needs of industrial markets such as high-quality building and building construction. The machine under study is the machine used for assembling the spun pile reinforcement frame in the rotary workshop. The purpose of this study is to analyze the application of Total Productive Maintenance (TPM) through the effectiveness and efficiency of heading machine performance and analyze the factors that affect the Overall Equipment Effectiveness (OEE) value and present a proposed heading machine maintenance strategy. The method used is OEE with Six Big Losses analysis. For the analysis of the six big losses on the OEE value, namely the value of Idle and minor stoppage (a decrease due to many machine stops) which is a factor that has the largest percentage of the six big losses with a resulting factor value of 7.0%. Then followed by reduced speed losses (decrease in engine speed) of 3.96% and then deffect losses of 3.48% and the three other factor values, namely breakdown losses, setup losses, and yield losses. Measurement of the level of effectiveness and efficiency of the heading machine at PT XYZ using the OEE method for the period 2022 in January - December obtained an average value of 78.28%. The resulting value is still far from the ideal OEE standard value of 85% which refers to the world class standard. The lowest OEE factor value is obtained from the calculation of Performance Efficiency of 86.29% where it is necessary to update the machine maintenance scheduling so as to increase the efficiency of the heading machine performance that supports the production speed of the company.

***Corresponding Author**

Rupertus Mario Serapion Leke
E-mail: erpinleke@gmail.com

1. INTRODUCTION

Spun piles are one of the precast concrete products that are often used as foundations in building construction. To meet market demand, precast concrete companies must ensure their production machines operate efficiently and consistently in producing large quantities of precast concrete. In practice, spun pile production machines often experience damage that can affect productivity at the company. One of the maintenance systems that can be applied is Total Productive Maintenance (TPM) which aims to improve the quality of maintenance involving all employees in the company, by ensuring that machine maintenance and repair are carried out continuously. Overall Equipment Effectiveness (OEE) is one method that can be used to analyze machine performance based on aspects in it such as availability, performance rate, and rate of quality which can then also be used to determine the six big losses related to these three aspects. Total Productive Maintenance is an innovative approach to maintenance that aims to optimize equipment effectiveness, eliminate breakdowns, and promote autonomous maintenance by operators through daily activities that involve the entire workforce. The objectives of Total Productive Maintenance include eliminating damage to machinery or equipment as well as product defects and other losses caused by machinery or equipment, increasing the effectiveness of machinery or equipment, increasing profits for the company and creating a healthy work environment (Simanjuntak, 2020). Overall Equipment Effectiveness (OEE) is a global method of measuring company effectiveness to evaluate how well equipment performs or functions. In addition, Overall Equipment Effectiveness (OEE) is used as an opportunity to increase productivity in the company, which is ultimately used as a step in making decisions. Overall Equipment Effectiveness (OEE) results are expressed in a generalized form that allows comparisons between manufacturing units in different industries (Muhajir & Yuamita, 2023).

The precast concrete produced is divided into two different wokshop areas, namely a rotary workshop with products produced in the form of spun piles and a non-rotary workshop with products produced in the form of Girder, Square Pile, CCSP, Uditch & Cover, Leg-Gutter, Box Culvert, U-Gutter and Lining Concrete. The main raw materials used in producing concrete are iron wire, sand and cement. The production activities of both types of concrete have almost the same production flow which starts from the process of assembling the iron frame, setting the mold, casting, stressing, drying and dismantling the molding. Each concrete production workshop area at PT XYZ has different production machines that are tailored to their needs. Production machines in the rotary workshop have a larger number compared to the non-rotary workshop. Therefore, the possibility of machine damage is more in the rotary workshop area, one of which is the heading machine used in the assembly process (wire caging), which is the process of making iron frames used for reinforcement in spun piles.

As one of the producers of quality spun pile, PT XYZ certainly requires machine maintenance to maintain the performance of machine performance so that it can produce superior spun pile products and can compete in the global market. If one of the production processes stops, it can be ascertained because of problems that occur in production machinery or equipment, such as decreasing production speed, sudden machine stops, increasing setup and adjustment time and machines producing defective products or machines operating but not producing products. Based on the above, researchers found a problem at PT XYZ where in the period of 2022 there was damage to the machine used for assembling the spun pile reinforcement frame in the rotary workshop. There are three types of machines used such as Bar Cutter, Heading and Wire Caging which are used for cutting iron, making hot upsetting on iron ware and welding iron frames. One of the machines that is often damaged is the heading machine, where there are several components that cause damage such as chassis that are easily worn out due to continuous gripping and rubbing against the PC bar, chassis clamping bolts that are often broken or loose due to pressure and impact from the heading hammer during the heating process on the PC bar and oil filters that are clogged due to dirt or dust that is carried in during the production process. The highest percentage of heading machine breakdown probability during the 2022 period occurred in February at 45%, in June at 45.8% and in October at 43.3%. The percentage of machine breakdowns that occur refers to the total machine breakdown time that occurs every month during the 2022 period so that it becomes one of the main factors in the decline in the performance of the heading machine in assembling the spun pile reinforcement frame.

Based on the above problems, the authors will conduct research related to the application of TPM using the Overall Equipment Effectiveness method as a process of combining operations management and maintenance of equipment and resources in determining heading machine maintenance strategies in order to maximize equipment effectiveness by involving all departments and functional organizations. Total Productive Maintenance itself is based on three interconnected concepts, namely maximizing the effectiveness of machinery and equipment, independent machine maintenance by workers and worker activities in the production division. The application of the OEE method can be used as a measuring tool to evaluate and improve the three TPM concepts appropriately to ensure increased productivity in the use of machinery and equipment so that it can be used as a consideration for improvement and maintenance in maintaining or increasing the effectiveness of the heading machine at PT XYZ.

2. LITERATURE REVIEW

The production system is the management of the conversion process from inputs to outputs, both in the form of manufactured products (goods) and services (services). Inputs can be in the form of land, workers, investment, management, technology, and others. While the output obtained is usually in the form of services, consumer goods and others (Haryono, 2019). According to (Andayati, 2019) the production system must have structural and functional components or elements that play an important role in supporting the operational continuity of the production system. The structural components or elements that make up the production system consist of materials, machinery and equipment, labor, capital, energy, information, land, and others. While the functional components or elements consist of supervision, planning, control, coordination, and leadership, all of which are related to management and organization. A process in a production system can be defined as the sequential integration of labor, materials, information, work methods, and machinery or equipment in an environment to produce added value for products, in order to be sold at competitive prices in the market. The process converts measurable inputs into measurable outputs through a number of organized sequential steps.

In carrying out a production process, every company certainly needs to carry out maintenance on every machine used. According to (Pranowo, 2019) maintenance is the concept of activities needed to maintain the quality of the machine so that it can function properly as its normal condition. Maintenance is a form of activity carried out to restore or maintain the condition of the machine so that it can always function. Maintenance is also a supporting activity that ensures the continuity of machinery and equipment so that when needed it can be used as expected. So that maintenance activities are a whole series of activities carried out to maintain machinery and equipment in operational and safe conditions, and if damage occurs it can be controlled. The production process requires maintenance activities which include cleaning, inspection, lubrication, and procurement of spare parts for its sustainability. Every type of maintenance work must have a purpose. In general, the purpose of maintenance is to keep the machine in good condition and make necessary repairs or adjustments or replacements so that there is a satisfactory state of production operations in accordance with what is planned (Rifandi, 2020). After the achievement of maintenance objectives, then the thing that needs to be considered next is the function of maintenance which is maintenance serves to extend the economic life of existing production machinery or equipment and strive for machinery or equipment production is always in optimal condition and ready to use for production process activities (Nursanti et al., 2019).

Maintenance activities of a factory company are divided into two types, namely preventive maintenance and corrective maintenance. Preventive maintenance is an effort made to prevent unexpected damage and find conditions or circumstances that can cause production facilities to be damaged when used in the production process. Meanwhile, Corrective or Breakdown Maintenance is an effort made after damage or abnormalities occur in the facility or equipment so that it cannot function properly. Each type of maintenance is an alternative choice of maintenance activities and maintenance financing (Widat et al., 2021). Total Productive Maintenance is an innovative approach to maintenance with the goal of optimizing equipment effectiveness, eliminating breakdowns, and promoting autonomous maintenance by operators through daily activities that involve the entire workforce. To fulfill these goals, preventive and predictive maintenance is required. The application of Total Productive Maintenance in the company is to improve the condition of the company based on improving the nature of employee work and machine conditions. The main subjects that become the basic idea of Total Productive Maintenance activities are humans and machines. In this case it is attempted to change the human mindset towards the concept of maintenance that has been used where humans can take care of their own equipment without relying on others. With this pattern, it is expected that the maintenance of machinery/equipment runs well so that damage can be prevented (Simanjuntak, 2020).

According to (Chair, 2022) if a company implements Total Productive Maintenance in its production activities, it can gain many benefits. The benefits are divided into two, namely direct benefits including; the company can achieve a minimum OPE (Overall Plant Efficiency) of 80% and a minimum OEE of 90%, can improve services so that there are no more complaints from customers, can reduce manufacturing costs by 30%, can fulfill consumer orders by 100%, can reduce accidents and apat follow pollution control measures. While the indirect benefits obtained by the company include; a high level of confidence between employees, can maintain the cleanliness and tidiness of the workplace, can improve the ability to do the work of the operator, can achieve goals by working as a team can horizontally describe new concepts in all areas of the organization, can share knowledge and experience and can instill a sense of ownership of the machine to workers.

The term OEE, which gauges the degree of equipment efficacy, is also acknowledged internationally. The assessment for the OEE value according to the global standard is 90% for availability, 95% for performance, and 99% for quality. The equipment has an exceptional OEE value of 85%. The six significant losses include excessive setup time, breakdown, rejection, and rework (Setiawan et al., 2022). According to (Siddiq et al., 2018) Overall Equipment Effectiveness is a value expressed as a ratio between the actual output divided by the maximum output of the equipment under the best performance conditions. The purpose of Overall Equipment Effectiveness is as a performance measurement tool of a maintenance system. By using this method, it can be known the availability of machinery or equipment (availability), production efficiency (performance) and the quality of the output of machinery or equipment. For this reason, the relationship between the three elements of productivity can be seen in the formula below:

$$\text{OEE} = \text{Availability x Performance efficiency x Rate of Quality Product x 100\%} \quad (1)$$

Availability (A) is a ratio that shows the time available to operate the machine. Availability is the ratio between actual machine operating time and planned machine operating time. The higher the availability value, the better (Wibisono, 2021). The availibility value can be calculated using the formula below:

$$A = \frac{\text{Loading Time} - (\text{Breakdown} + \text{Setup})}{\text{Loading Time}} \text{ x } 100\% \quad (2)$$

Performance (PE) is a measure of the efficiency of a machine performance running the production process. The performance rate expected by the company is that there is no decrease in standard machine speed compared to the actual. Perfomance rate is the result of multiplying the operating speed rate by the net operating speed. Net operating speed is useful for calculating the decrease in production speed (Dipa et al., 2022). Three important factors for calculating performance rate are ideal cycle time (ideal cycle time or standard time), processed amount (number of products processed) and operation time (machine process time). The performance rate value can be calculated using the formula below:

$$PE = \frac{\text{Processed Amount x Ideal Cycle Time}}{\text{Operating Time}} \text{x } 100\% \quad (3)$$

Quality Rate (QR) is the ratio of products that pass quality control to total production. Quality rate is also the ratio of the number of good products to the number of products processed (B. G. Sitompul & D. I. Rinawati, 2019). So quality is the result of calculations with the processed amount and defect amount factors. Products that pass quality control are called goods. Meanwhile, products that do not pass quality control are called reject and pending products because these products will be immediately repaired by sorting. The quality rate value can be calculated using the formula below:

$$QR = \frac{\text{Processed Amount} - \text{Produk Cacat}}{\text{Processed Amount}} \text{x } 100\% \quad (4)$$

In a business setting, OEE may be applied at several levels, including: (a) OEE may be used as a "benchmark" to assess a company's performance goals; (b) OEE value, which is an estimate of production flow, can be used to evaluate a company's cross-line performance, giving the impression that the flow is unimportant; and (c) Assume each step of the machining process is completed by hand. In that situation, OEE may pinpoint the machines that are performing poorly and even show that concentrating TPM efforts on increasing the OEE value necessitates strong collaboration between all lines (Marfinov & Pratama, 2020). After the OEE analysis is carried out, it will be known that the average calculation of the OEE value has met the standards set by the world or not. If the average OEE value does not meet the standard, it is necessary to analyze the six big losses to find out in more detail the cause of the OEE value being below the standard. Six Big Losses are common factors that most often cause machinery or production equipment to work inefficiently during the production process. There are six equipment losses that cause the low level of effectiveness of the six big losses equipment including equipment failure losses, setup and adjustment losses, idle and minor stoppage losses, reduce speed losses, defect losses and reduce losses (Vianty et al., 2022).

Referring to the research conducted, there have previously been studies using similar topics and methods. However, there are differences in the object, time and location carried out in this study, which is carried out research on the heading machine which is one of the machines found in the wire caging area at the rotary worksop owned by PT XYZ which is engaged in the precast and ready mix concrete industry located in Sidoarjo district, East Java for a period of 2022. Information and data were obtained by interviewing the head of the mechanical department directly, machining and retrieving secondary data. Secondary data was obtained for the period January to December 2022.

3. RESEARCH METHOD

This research was conducted by taking a case study at PT XYZ. In this study, it is carried out to analyze the analysis of Total Productive Maintenance using the Overall Equipment Effectiveness method, which begins with a discussion of the material and conditions at the research location in order to identify the problems that occur and determine the research variables, To analyze the value of Overall Equipment Effectiveness, working time machine data, planned downtime machine data, downtime machine data, breakdown machine data, setip machine data, processed amount data and deffect amount data are required. The next stage is the calculation of the average value of OEE by calculating the value of availability, performance efficiency and quality rate. The results of the average OEE value are then compared with the world standard value, if it does not meet these standards, it is necessary to analyze the Six Big Losses. Six Big Losses analysis is carried out to determine the factors that cause the OEE value to not meet the standard by calculating downtime losses, setup and adjustment losses, idling and minor stoppages, reduced speed losses, processed defects and reduced yield losses. The Fishbone method is used to determine the root cause of losses, in order to prioritize the damage that occurs on the machine so that periodic scheduled maintenance can be carried out using a comprehensive machine maintenance proposal. The Fishbone method is used to determine the root cause of losses, in order to prioritize the damage that occurs to the machine so that regular maintenance can be scheduled using the proposed machine maintenance method. This machine maintenance proposal can be applied by the company in order to increase efficiency in the production process in the future.

4. RESULT AND DISCUSSION

4.1 Overall Equipment Effectiveness (OEE)

In this study, the effectiveness of the Heading machine used to produce spun pile frames is calculated. To perform this calculation, the components needed in the Overall Equipment Effectiveness method consisting of availability ratio, performance efficiency, and rate of product quality are required. The data was obtained by observing the rotary workshop area at PT XYZ, Information was also obtained by conducting interviews with the head of the mechanical department, machining and taking secondary data. Secondary data obtained during the period January to December 2022 (in minutes) are presented in Table 1.

Table 1. Heading machine data collection

Period 2022	Working Time	Planned Downtime	Breakdown Time
Jan	9600	108	108
Feb	9600	270	523
Mar	9996	126	138
Apr	9840	234	240
May	9600	180	210
Jun	9600	270	612
Jul	9906	222	240
Aug	9600	180	126
Sept	10140	222	270
Oct	9600	108	312
Nov	9600	126	282
Dec	10068	108	84
Jan	208	108	108
Feb	245	270	523
Mar	187	126	138
Apr	224	234	240
May	222	180	210
Jun	248	270	612
Jul	229	222	240
Aug	226	180	126
Sept	221	222	270
Oct	223	108	312
Nov	226	126	282
Dec	244	108	84

(Source: company secondary data)

The availability ratio (A) value of the heading machine represented in January 2022 can be calculated using the following formula:

$$A = \frac{\text{Loading Time} - (\text{Breakdown+Setup})}{\text{Loading Time}} \text{ x } 100\%$$
$$= \frac{(9600+108)-(108+208)}{9492} x\ 100\%$$
$$= \frac{9176}{9492} x\ 100\%$$
$$= 96{,}67\%$$

The average value of the Availability ratio (A) for the operation of machinery or equipment on the heading machine research in the period January to December 2022 resulted in a very good average of 94.89% (Table 3). The percentage value can be said to have met the standards set by the world with the ideal availability ratio value being at OEE> 90%. Next, the performance efficiency (PE) value of the heading machine represented in January 2022 can be calculated using the following formula:

$$PE = \frac{\text{Processed Amount x Ideal Cycle Time}}{\text{Operating Time}} \text{ x } 100\%$$
$$= \frac{272\ x\ 23{,}06}{9176} x\ 100\%$$
$$= 68{,}37\%$$

The average value of the performance efficiency (PE) for the operation of machinery or equipment on the heading machine research in the period January to December 2022 resulted in a poor average of 94.89% (Table 2). The percentage value can be said to not meet the standards set by the world with the ideal performance efficiency value being at OEE> 95%. The last component of OEE is the quality rate (QR) value of the heading machine represented in January 2022 which can be calculated using the following formula:

$$QR = \frac{\text{Processed Amount} - \text{Produk Cacat}}{\text{Processed Amount}} \text{ x } 100\%$$
$$= \frac{(272-14)}{272} x\ 100\%$$
$$= 94{,}85\%$$

The average value of the quality rate (QR) for the operation of machinery or equipment on the heading machine research in the period January to December 2022 resulted in a poor average of 94.89% (Table 2). The percentage value can be said to have met the standards set by the world with the ideal quality value being at OEE> 99%. After that, continue to calculate the OEE value based on the results of the multiplication of the

3 important factor values in the effectiveness of the machine above using the following formula:

$$\text{OEE} = \text{Availability x Performance efficiency x Rate of Quality Product x 100\%}$$
$$= 94{,}89\ x\ 86{,}29\ x\ 95{,}61\ x\ 100\%$$
$$= 78{,}28\%$$

Table 2. Average value of OEE components

Period 2022	A	PE	QR
Jan	96.67	68.37	94.85
Feb	91.77	97.12	96.75
Mar	96.71	89.26	96.70
Apr	95.17	94.66	95.89
May	95.41	64.67	94.84
Jun	90.78	99.18	95.78
Jul	95.16	95.10	96.39
Aug	96.26	96.43	92.82
Sept	95.05	72.91	93.29
Oct	94.36	98.21	92.08
Nov	94.64	69.97	98.90
Dec	96.71	89.57	99.05
Average	94.89	86.29	95.61

(Source: processed data)

Based on Table 2, it can be seen that the average availability value (A) is 94.89%, performance efficiency (PE) is 85.99% and quality rate (QR) is 95.61%. it can be seen from the three factors that affect the low value of Overall Equipment Effectiveness is performance efficiency (PE) and quality rate (QR).

Table 3. Comparison of company OEE values and worldclass standards

Components	World Class Standard	Company Value
Availability	90%	94.89%
Performance Efficiency	95%	86.29%
Rate of Quality Product	99%	95.61%
OEE	85%	78.28%

(Source: processed data)

Based on the average value obtained from the calculation of the three OEE components, it can be seen the comparison of the value of the components produced by the company with the standard value determined by the world class in Table 3.

4.2 Six Big Losses

The Six Big Losses can be considered as common factors that cause ineffectiveness in machines. The six factors are equipment failure losses (EF), setup and adjustment losses (SL), idle and minor stoppage losses (IL), reduce speed losses (RSL), process defect losses (PD) and yield losses (YL). Based on the OEE value, it is necessary to evaluate the factors that cause the low OEE value, especially in performance and quality rate. Therefore, the Six Big Losses analysis is carried out, so that it will be known what factors affect the low OEE value. The six big losses method of the heading machine represented in January 2022 can be calculated using the following formula:

$$\text{EF} = \frac{\text{Breakdown Time}}{\text{Operating Time}} \text{ x } 100\%$$
$$= \frac{108}{9176}\ x\ 100\% = 1{,}18\%$$

$$\text{SL} = \frac{\text{Total Setup}}{\text{Loading Time}} \text{ x } 100\%$$
$$= \frac{208}{9492}\ x\ 100\% = 2{,}2\%$$

$$\text{IL} = \frac{(\text{Breakdown Time+Setup+Planned Downtime})}{\text{Loading Time}} \text{ x } 100\%$$
$$= \frac{424{,}0}{9492}\ x\ 100\% = 4{,}5\%$$

$$\text{RSL} = \frac{\text{Operation Time}-(\text{ICT x Processed Amount})}{\text{Loading Time}} \text{ x } 100\%$$
$$= \frac{9176-(23{,}06\ x\ 272)}{9492}\ x\ 100\% = 2{,}75\%$$

$$\text{PD} = \frac{\text{ICT x Rework}}{\text{Loading Time}} \text{ x } 100\%$$
$$= \frac{23{,}06\ x\ 14}{9492}\ x\ 100\% = 3{,}40\%$$

$$\text{YL} = \frac{\text{ICT x Reject}}{\text{Loading Time}} \text{ x } 100\%$$
$$= \frac{23{,}06\ x\ 0}{9492}\ x\ 100\% = 0\%$$

Table 4. Average value of six big losses components

Period 2022	EF	SL	IL	RSL	PD	YL
Jan	1.18	2.2	4.5	2.75	3.40	0
Feb	3.78	2.6	11.1	6.55	5.44	0
Mar	1.45	1.9	4.6	4.51	3.04	0
Apr	2.63	2.3	7.3	1.45	4.56	0
May	2.34	2.4	6.5	2.99	3.18	0
Jun	3.90	2.7	12.1	6.38	6.92	0
Jul	2.60	2.4	7.1	2.22	4.29	0
Aug	1.39	2.4	5.6	4.60	3.18	0
Sept	2.86	2.2	7.2	2.53	4.65	0
Oct	3.48	2.3	6.8	6.29	1.94	0
Nov	3.15	2.4	6.7	2.55	0.73	0
Dec	0.87	2.4	4.4	4.74	0.46	0
Average	**2.47**	**2.4**	**7.0**	**3.96**	**3.48**	**0**

(Source: processed data)

Based on the results of the Six Big Losses calculation in table 5 above, it can be seen that the highest average value of losses is idle and minor stoppage (a decrease due to frequent engine stops) of 7.0%. reduced speed losses (decrease in engine speed) of 3.96%, deffect losses of 3.48%, breakdown losses of 2.47%, setup losses of 2.4%, and yield losses of 0%. It can be seen that the most influential losses are idle and minor stoppage and reduced speed losses, where there are many factors that cause the value of losses to be so large.

4.3 Analysis of Cause and Effect Diagram

The following is a diagram of the cause and effect analysis obtained based on the results of the calculation of the six big losses. It can be seen that the factors causing the decrease in OEE value on the heading machine are idle and minor stoppage values and reduced speed losses with the highest loss value among others caused by several factors, namely humans, machines, and the environment. The factors that cause a decrease in OEE value can be seen in the following Figure 1.

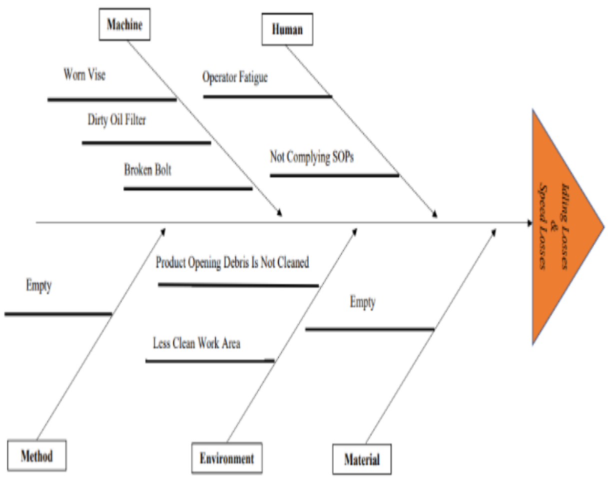

Figure 1. Fishbone diagram
(Source: processed data)

Based on the fishbone diagram above, the causes of damage and proposed maintenance of the heading machine can be analyzed in the Table 5.

Table 5. Fishbone diagram analysis

Consequences	Causal Factors	Root Causes	Suggested Improvements
Idle and Minor Stoppage & Reduced Speed Losses	Man	Operators Fatigue	Maximize rest time for operators and change work shifts on time.
		Lack of compliance with SOP	Conduct training and socialization of applicable SOPs to operators
	Machine	Worn Vice Dirty Oil Filter	Scheduling component replacement and checking component condition regularly
		Broken Bolt	
	Environment	Uncleaned Product Opening Debris	Performing cleaning directly in the mold opening area during product opening
		Less Clean Work Area	Always keep the surrounding environment clean before and after doing work

(Source: processed data)

Based on the results of the analysis in the table above, there are three main factors that affect the decrease in OEE value including, factors caused by humans, namely operator fatigue due to repetitive activities and compacted production due to pursuing production targets so that work performance decreases. Factors caused by the machine are the many damages that hinder the production rate such as damage to the ragum (easily worn), bolts that are often broken, and oil filters that are often jammed due to dirt that is carried in during the production process. While factors caused by the environment include the workspace or production area which is still less clean, causing dirt or dust to be easily absorbed and carried into the oil filter which can hinder and slow down the performance of the engine which initially the engine speed is stable to decrease so that an oil filter replacement must be done to maximize engine speed again. Both are the top priorities that need to be done to improve the system which in turn can increase the OEE value. After doing some analysis, it is found that the factors that are the most influential causes of the low OEE value and these factors will be further addressed in order to be able to increase OEE and minimize existing losses:

1) Currently PT XYZ only has a break at 12.00 -13.00 AM. This is considered ineffective with the workload experienced by operators who work more than 8 hours every day and repetitive work. Operators quickly experience saturation and fatigue so that their performance and accuracy decrease. Rest breaks with a frequency of 5-15 minutes every 1-2 hours of work are sufficient to reduce fatigue, increase productivity, and reduce the risk of work accidents.
2) We recommend making maintenance procedures in the form of inspection and cleaning and conducting regular maintenance, then the mechanic makes a checklist form that is intended for the operator. The checklist form has the function that if the operator has carried out the activity, the form can be filled in and then checked by the company owner.
3) It is better to use a checklist form intended for operators in installing and adjusting before and after the production process. The checklist form will be checked by the company owner directly before and after the work is done by the operator. The checklist form that has been made about how to install and adjust a piece of equipment so that it is done with great precision.

It can be seen that Total Productive Maintenance (TPM) analysis using the Overall Equipment Effectiveness (OEE) method has never been applied to the PT. XYZ in question, where previously the method used was corrective maintenance which means that maintenance is carried out when the machine is damaged. done when the machine is damaged only. This is certainly very ineffective for the company where if there is heavy damage to the equipment it will incur large costs. Because the equipment cannot be used during maintenance, mechanical costs will increase due to overtime. Therefore, it is necessary to improve the maintenance of machinery and equipment in detail using the the Overall Equipment Effectiveness (OEE) method in which there is an analysis of the calculation of availability, performance efficiency and quality rate which is very effective in identifying, analyzing and improving processes, products and services. If the value of the the Overall Equipment Effectiveness (OEE)analysis does not meet the standards set by the world, then an analysis of the six big losses can be carried out to find out in detail the causes of failure or damage that cause a decrease in machine performance. So that it can improve the quality of service better and can increase industrial profits and competitiveness.

5. CONCLUSION

Measurement of the level of effectiveness and efficiency of the heading machine at PT XYZ using the overall equipment effectiveness (OEE) method for the period 2022 in January - December obtained an average value of 78.28%. The resulting value is still far from the ideal OEE standard value of 85% which refers to the world class standard (Japan Institute of Plant Maintenance). The lowest OEE factor value is obtained from the calculation of Performance Efficiency of 86.29% where it is necessary to update the machine maintenance scheduling so as to increase the efficiency of the heading machine performance that supports the production speed of the company. Idle and minor stoppage (decrease due to many machine stops) is a factor that has the largest percentage of the six big losses with a resulting factor value of 7.0%. Then followed by reduced speed losses (decrease in engine speed) of 3.96% then deffect losses of 3.48% and the other three factor values, namely breakdown losses, setup losses, and yield losses. Therefore, it is necessary to carry out maximum maintenance on machine components that are often in trouble such as oil filters, ragums and ragum flanking bolts so as to reduce the occurrence of machines that often stop suddenly and increase the speed of production machines.

The suggestions that can be given through this research are: (1) The company should schedule the replacement of spare parts and components based on the most frequent level of damage without the need to wait for the breakdown of the machine first, (2) The company should use components that are in accordance with the default machine (original) or make custom machine components but still pay attention to the quality of the material so as to extend the service life of the components In addition, the company should provide spare parts or components that have a long delivery time, and (3) The company should appeal to all employees and operators to raise awareness to be well responsible for the machines used and have the initiative to maintain and improve the efficiency of the machines in the company.

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