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Implementation of Repairing Production Machine Productivity of Spare Parts Speaker Based on OEE Value Achievement

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ABSTRACT

The industry under study is a company in the field of making Speaker, Megaphone and Amplifier. In this study, the Thoshiba IS 350 GS 350 Ton machine has observed. Constraints such as when producing machine Speaker Parts produce high reject products up to 7% of the total monthly production. When operating the machine often experiences downtime due to damage to the engine. Damage causes high employee overtime due to having to pursue production targets and the costs to be incurred by the company can reach Rp. 3 billion per month. Evaluation is done by calculating Overall Equipment Effectiveness (OEE) and comparing with OEE before repairs. Furthermore, discussed the factors that influence the effectiveness of the Injection molding machine contained in the six big losses and other problems where the method of analysis with fishbone diagrams. After that, the discussion was conducted using the analysis of Failure Mode and Effect Analysis (FMEA) to identify and analyze potential failures and their consequences. From the results of the observation, the main cause of damage to the Thoshiba IS 350 GS 350 Ton machine is the low Performance Rate with an average value of 63.5% in April 2018, this is caused by the value of Reduced Speed Losses that have the biggest contribution in six big losses with a loss of 86.9 hours which results in the Thoshiba IS 350 GS 350 Ton Machine not working optimally.

1. Introduction

To reduce production costs the company must study various types of losses in the manufacturing industry and classify them [1]. Total Productive Maintenance (TPM) builds a close relationship between maintenance and productivity, so that it can show how well equipment maintenance will result in higher productivity [2]. TPM is as a method for increasing the availability of production machinery through better utilization of maintenance and production control [3].

One of the work measurement methods used in measuring the success of TPM is Overall Equipment Effectiveness (OEE) [4]. The success rate of implementing TPM is measured using the OEE method [5], where OEE is the main performance indicator, which shows the current production status with calculations [6]. The three basic components of OEE consist of availability rate, performance rate, and quality rate. These factors help to measure production efficiency and effectiveness [7]. To become a profitable company, the company must have an OEE value of at least 84.66% with the composition of

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the OEE as shown in Table 1 [8]. Overall, the value of OEE of 85% is considered as a world class performance that must be achieved which requires an availability rate of 90%, a performance rate of 95%, and a quality rate of 99% [2].

Table 1. *Standard of overall equipment effectiveness (OEE).*

Factor	Value
Availability Rate (A)	≥ 90 %
Performance rate (P)	≥ 95 %
Rate of Quality (R)	≥ 99 %
OEE	≥ 84,66 %

It is important to apply the Failure and Effect Analysis Mode (FMEA), to realize the successful molding injection process and to ensure a strong design of the process [9]. Many studies that use FMEA as a risk analysis technique have shown successful implementation [10]. FMEA regulates the principle of identifying and prioritizing possible failures or defects [11]. FMEA is one of the first systematic techniques that are highly structured for failure analysis [12]. FMEA aims to classify failures that occur in accordance with the value of the Risk Priority Number (RPN) [13]. FMEA is used after obtaining factors that affect failure or disability in order to obtain which factors require further handling. By looking at the analysis of FMEA, we can find out the potential causes that need immediate corrective action. The FMEA utilizes indicators (RPN), which are defined as products of severity (S), incidence (O), and detection (D) of failure [14].

The industry under study is a company engaged in the manufacture of Speakers, Megaphones, and Amplifiers. In this study, the Injection Molding machine with the Thoshiba IS 350 GS 350 Ton engine type has observed. This machine has a relatively long life, but is still reliable because the need for this machine is quite high. There are several obstacles on this machine, including when producing Speaker spare parts machines produce reject products that are high enough to reach 7% of the total production per month. When operating the machine often experiences down time due to damage to the engine. Damage to the engine causes high employee overtime due to the need to pursue production targets, even the large amount of costs the company has to spend can reach Rp. 3 billion per month. With frequent damage to the engine causes the pr oduction process to become longer and has an impact on the delay in delivery to consumers. In this company there is also no scheduling of engine maintenance so that many machines are repaired if the engine breaks down.

From the constraints that exist on the Thoshiba IS 350 GS 350 Ton engine, the OEE measurement will be carried out by considering three important things, namely availability rate, performance rate, and quality rate. The three types of factors are further elaborated into several types of Six Big losses, namely equipment failure losses, set up and adjustment, idle and minor stoppage, reduce speed, defect losses and scrap losses.

The purpose of this study based on the formulation of the problem above is to measure the value of OEE from a machine that produces speaker spare parts products. Knowing the main root causes of frequent damage to the engine and knowing how to solve the problem so that it can increase machine productivity.

2. Material and Methode

In this study to produce a part of speaker spare parts the company uses an injection molding machine with various machine sizes. The selection of the engine size is adjusted to the size of the speaker spare parts that you want to make. The raw material used in the injection molding machine is plastic ore. The performance of the injection molding machine will be assessed and observed as any constraints on the Thoshiba IS 350 GS 350 Ton engine, which causes a decrease in productivity.

The population in this study are all data recordings of the spare part speaker production, while the sample taken in this study is a recording of the production of spare part speaker during the period April 2018-May 2018.

This research is explorative descriptive by looking for the root of the problems that occur in the decline in the value of OEE on the Thoshiba IS 350 GS 350 Ton Machine and making strategy solutions, and describing the matters related to the occurrence of downtime that occurs. After data collection, a study of observations on the implementation of the repairs is carried out and evaluated whether the improvements are made effectively by calculating OEE and comparing with OEE before repairs. Furthermore, we discuss the factors that influence the effectiveness of the injection molding machine contained in the six big losses and other problems where the method of analysis with fishbone diagrams. After that, the discussion is conducted using the analysis of FMEA to identify and analyze potential failures, and their consequences.

3. Results and Discussion

In this study the main goal to be achieved is to measure the achievement of the value of OEE of the Thoshiba IS 350 GS 350 Ton machine so that it can be used as a reference to make improvements that will be made to achieve the OEE value targeted by the company. Furthermore, by measuring the root causes of the most frequent damage to the Thoshiba IS 350 GS 350 Ton engine, so that an alternative analysis can be done to solve the problem which in turn can increase the productivity of the Thoshiba IS 350 GS 350 Ton Engine.

The OEE calculation analysis is carried out to see the level of productivity of the engine in the Thoshiba IS 350 GS 350 Ton engine during the period April 2018 and May 2018. This OEE measurement is a combination of time, engine quality, and engine speed. To determine the value of availability rate, performance rate, quality rate, and OEE Thoshiba IS 350 GS 350 Ton machine for 2 months so that the OEE value is obtained as follows. The following is a table and graph of the comparison of OEE in April 2018 and May 2018 which can be seen in Table 2 and Fig. 2.

Table 2. *OEE comparisons in April 2018 and May 2018.*

No.	Information	Value of April 2018	Value of Mei 2018
1	Availability Rate	95,21%	97,38%
2	Performance Rate	63,50%	70,23%
3	Quality Rate	93,37%	94,46%
4	OEE	56,22%	64,60%

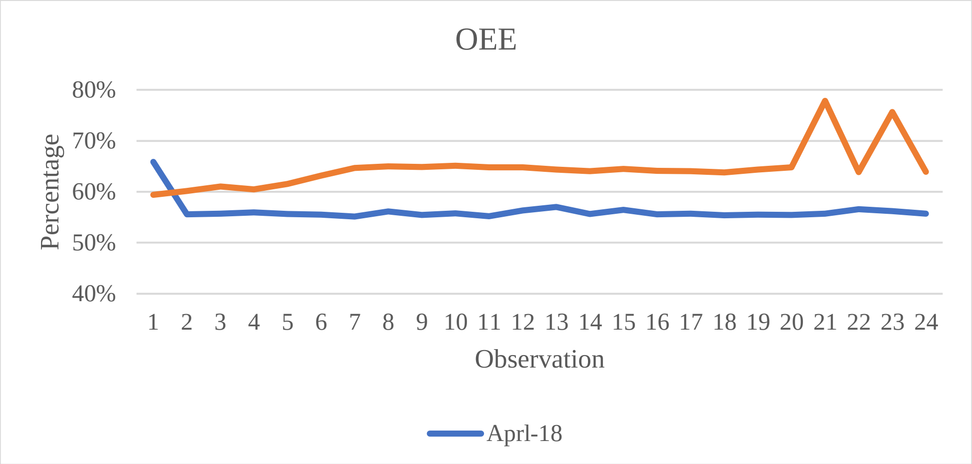

Fig. 1. *Comparison of OEE charts in April 2018 and May 2018.*

Based on the Fig. 1 graph of OEE comparison above, it can be seen that the achievement of OEE in April 2018 from the Thoshiba IS 350 GS 350 Ton Machine is below the standard, with an average value of 56.22%. The value for the world OEE standard is 85.00%. The value that greatly influences OEE is that the performance rate value is 60.94% - 78.71%, which makes OEE not reach the company's target, the value is still far below the value standards of OEE for performance rate which is > 95.00%. It can be seen in Fig. 1 the graph of the OEE comparison above after engine overhaul OEE in May 2018 has improved, the average value of OEE has increased to 64.6%. However, this is still not enough to achieve world OEE, which is 85.00%.

The calculation of losses analysis aims to find out the losses that make the biggest contribution in reducing the productivity of the Thoshiba IS 350 GS 350 Ton Engine. The percentage of losses in April 2018 and May 2018 that contribute from large to small can be seen in Table 3 and Table 4 below.

Table 3. *Six big losses calculation results April 2018.*

No.	Factor OEE	Big Loss	Total Loss Time (hours)	Percentage %	Kum %
1	A	Equipment Failure	13,10	11,31	11,31
		Set up & Adjustment	2,33	2,01	13,32
2	P	Idle and minor stoppage	0,08	0,07	13,39
		Reduced Speed	86,90	75,01	88,41
3	Q	Deffect Losses	13,43	11,59	100
		Scrap Losses	0	0	100
Total			115,85	100	

Table 4. *Six big losses calculation results May 2018.*

No.	Factor OEE	Big Loss	Total Loss Time (hours)	Percentage %	Kum %
1	A	Equipment Failure	6,58	10,54	10,54
		Set up & Adjustment	1,88	3,02	13,56
2	P	Idle and minor stoppage	0,04	0,06	13,62
		Reduced Speed	41,23	66	79,62
3	Q	Deffect Losses	12,73	20,38	100
		Scrap Losses	0	0	100
Total			62,46	100	

Based on Table 3, the results of the calculation of six big losses April 2018 above show that the greatest losses are found in the OEE performance rate element, reduced speed with a value of 86.90 hours or 75.01%, which contributes the most to the causes of the low Thoshiba IS Machine. 350 GS 350 Ton. This shows the low actual speed of the engine makes the performance of the Thoshiba IS 350 GS 350 Ton Engine drop due to the large number of recycled products during the production process.

The second factor causing losses is defect losses of 13.43 hours or 11.59% due to the time the equipment is wasted to produce reject products when the engine is running continuously after adjustment and adjustment. These two factors led to the production target of the Thoshiba IS 350 GS 350 Ton Engine not being reached.

In Table 4, the results of the calculation of six big losses in May 2018 there is a reduction in Losses after repairs. Although it has not yet reached the world standard OEE target, it has been able to improve reduced speed with a value of 41.23 hours.

Next is an analysis of FMEA to identify and analyze failures that have occurred or that may occur, with the aim of preventing these failures from having a negative impact on the results of a process. At this stage what is done is identifying potential failure mode, identifying failure effect, determining the severity, occurrence, and detection values that will be determined by experts from the company, where in this study the SOD value is determined by the Thoshiba IS 350 GS 350 Ton quality control machine, which in the end the SOD value will be calculated as the Risk Priority Number (RPN). The FMEA can be seen in Table 5.

Based on Table 5 below, the results of the largest RPN that will be prioritized consist of machine factors, namely poor machine performance with an RPN value of 392. Then the operator factor is less careful in paying attention to engine performance with a RPN value of 249. From the RPN value the highest priority can be concluded that these two factors have the most influence on reject products and need to be improved.

Tabel 5. *Failure mode and effect analysis (FMEA).*

Descrition	Mode of Failure	Cause of failure	Effect of failure	S	O	D	RPN	Rank
Reduced Speed Losses	The Toshiba IS 350 GS 350 Ton engine is old. engine breakdown often occurs.	Lack of maintenance and checking	Poor engine performance	8	7	7	392	1
	The quality of raw materials is not standard, the control is not periodic, the instability of raw materials that are easily clumped is left unchecked.	Lack of inspection of raw materials	Raw materials are damaged	6	4	5	120	4
	Lack of concentration of employees chatting outside the work area and operators in working in a hurry because of the high pressure of production targets.	Experiencing fatigue	Less careful in paying attention to engine performance	7	7	6	249	2
	Hot room temperature employee working conditions	Less attention to	Operators easily	6	3	4	72	5

Descrition	Mode of Failure	Cause of failure	Effect of failure	S	O	D	RPN	Rank
	are not comfortable, room stability is not standard.	environmental comfort	experience eye fatigue					
	Lack of standard knowledge of work, namely production SOP, absence of maintenance schedule.	Lack of checking	Output does not meet standards	7	7	6	249	3

To increase the value of OEE, efforts need to be continually improved; in Table 6 an action plan is proposed to increase OEE.

Table 6. *Plan of action to increase OEE value.*

Factor	Problem	Action Plan
Human	Lack of concentration of employees or operators at work due to high production target pressure.	It is necessary to provide guidance to employees or operators to improve work concentration.
Material	The instability of raw material that is easy to clot is left.	Involving quality control in checking raw materials and making periodic controls so that the existing material is not too much clumping.
Method	Lack of standard knowledge of workmanship.	There needs to be training for employees to increase work knowledge and skills of employees.
Machine	The old Thoshiba IS 350 GS 350 Ton engine.	Engaging the engineering department to make repairs and maintenance on the machine.
Environment	The required temperature is not in accordance with the standard temperature during the production process.	Making standards about the right temperature in accordance with the conditions of the production room.

4. Concluisons

The main cause of damage to the Thoshiba IS 350 GS 350 Ton machine was the low performance rate with an average value of 63.5% in April 2018. This is caused by the value of reduced speed losses that have the biggest contribution in six big losses (losses) with a loss time of 86.9 hours which resulted in the Thoshiba IS 350 GS 350 Ton Machine not working optimally. Suggestions that can be given in this study are that the company should implement OEE as an effort to control the performance of production machinery. So that the production flow can run effectively and efficiently, and the production target can be achieved.

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