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Machine Optimization of SNK HF Fabrication Plant in PT. Komatsu Indonesia with FMEA Method and Overall Equipment Effectiveness (OEE)

Titus Argarino[1*], Melya Dyanasari Sebayang[2*], and Bantu Hotsan Manullang[3]

[1]*Department of Mechanical Engineering, Faculty of Engineering, Universitas Kristen Indonesia*
[2]*Department of Mechanical Engineering, Faculty of Engineering, Universitas Kristen Indonesia*
[3]*Department of Mechanical Engineering, Faculty of Engineering, ITBU, Indonesia*

Abstract. The effectiveness of a machine is an important thing in the production process; the losses that arise can cause time losses and hamper the process, especially in vital production facilities. The SNK HF machine is a machine with category A or critical with the highest damage occurring throughout 2019–2020. Analysis of the condition of the machine's effectiveness in this study was done by using the overall equipment effectiveness (OEE) method, namely by knowing the conditions of availability, performance and quality. The results of the OEE analysis are followed by a failure mode effect analysis (FMEA) to overcome the problems that occur. The condition of machine damage and the availability of machine parts are the factors that most affect the decrease in the effectiveness of the SNK HF machine.

Keyword: Overall Equipment Effectiveness, Failure Mode Effect Analysis, SNK HF.

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1 Introduction

PT. Komatsu Indonesia has several machines with category A, which is a top priority with the criteria of no replacement machine, big machine category, imported machine components and if there is damage it will have a big impact on the production process. The SNK HF planomilling machine is a class A priority machine to process excavator, dump truck and dozer components with the highest damage in 2020 reaching 57.5 hours [1][2]. In this analytical study, it is focused on the condition of machine effectiveness and the causes of losses that occur with the limitation of the machine problem under study is SNK HF and the data used are from 2020 and 2021. The purpose of the study is to identify the factors that cause damage to the SNK HF

*Corresponding author at: Jalan Mayjen Sutoyo No.2, Cawang, Kec. Kramat jati, Kota Jakarta Timur, Daerah Khusus Ibukota Jakarta 13630

E-mail address: argarino.titus@gmail.com; melcan_sebayang@yahoo.co.id

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machine using OEE and FMEA and improve availability, performance and quality on SNK HF machines [3][4].

2 Methods

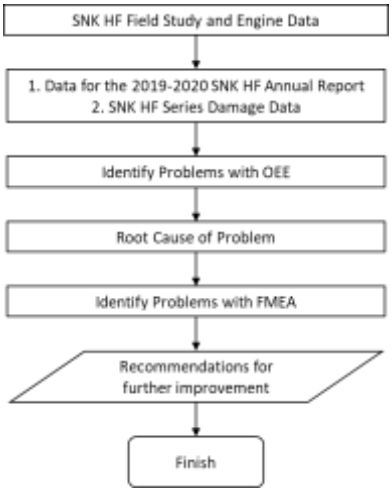

Figure 1. Flowchart of the research

The research process begins with a field study to study the actual condition of the SNK HF machine and continues with annual breakdown data analysis. The analysis is continued with OEE and FMEA to produce a recommendation for improvement.

2.1 Data Collection

Data collection related to the production process on the SNK HF machine for the period April 2020 – March 2021 includes: breakdown time data, production data, breakdown data.

2.2 Analysis OEE

Analyze the condition of the machine by analyzing each component, namely: availability, performance and quality. The calculation results are compared with the JIPM standard, which is 85% [5][6][7].

$$OEE = Availability \times Performance\ x\ Quality \quad (1)$$

The standards for each component are as follows: Availability: 95%, Performance: 99% and Quality: 100%. If there are conditions below the standard, it needs to be analyzed further. Calculation uses the formula (2) [8][9][10].

$$Availability = \frac{Available\ Time\text{-}Down\ Time}{Available\ Time}\ x\ 100\% \quad (2)$$

Performance calculation uses formula (3) [6].

$$\text{Performance} = \frac{\text{Qty Item x Cycle Time}}{\text{Operating Time - Speed loses}} \text{ x } 100\% \quad (3)$$

Quality calculation uses formula (4) [11].

$$Quality = \frac{Prodeucted\text{-}Deffect}{Producted} \; x\; 100\% \quad (4)$$

2.3 Analyis FMEA

FMEA analysis is carried out to determine the mitigation actions from the source of the decrease in machine effectiveness in OEE. FMEA calculation uses severity, occurrence, and detection components [12][13].

$$FMEA = Severity \times Occurance \text{ x } Detection \quad (5)$$

Each component (Severity, Occurrence and Detection) is analyzed with several rating categories.

3 Result and Discussion

The OEE condition of the SNK HF machine is below the standard, namely in the availability component. Availability achievement is still below the 95% standard with a maximum achievement of 77.80% [14].

Table 1. OEE of SNK HF Machine Period Sep'20 – Feb'21

Month	OEE SNK HF			
	Availability (%)	Performance (%)	Quality (%)	OEE (%)
Sep '20	70.90	97.40	100	69.06
Oct '20	74.50	96.50	100	71.89
Nov '20	74.70	96.20	100	72.09
Dec '20	74.90	96.20	100	72.05
Jan '21	76.80	96.60	100	74.18
Feb '21	77.80	97.60	100	75.93

Low availability conditions are influenced by several factors, namely machine breakdown, control problems, cutting coolant problems, idle components and problems [15].

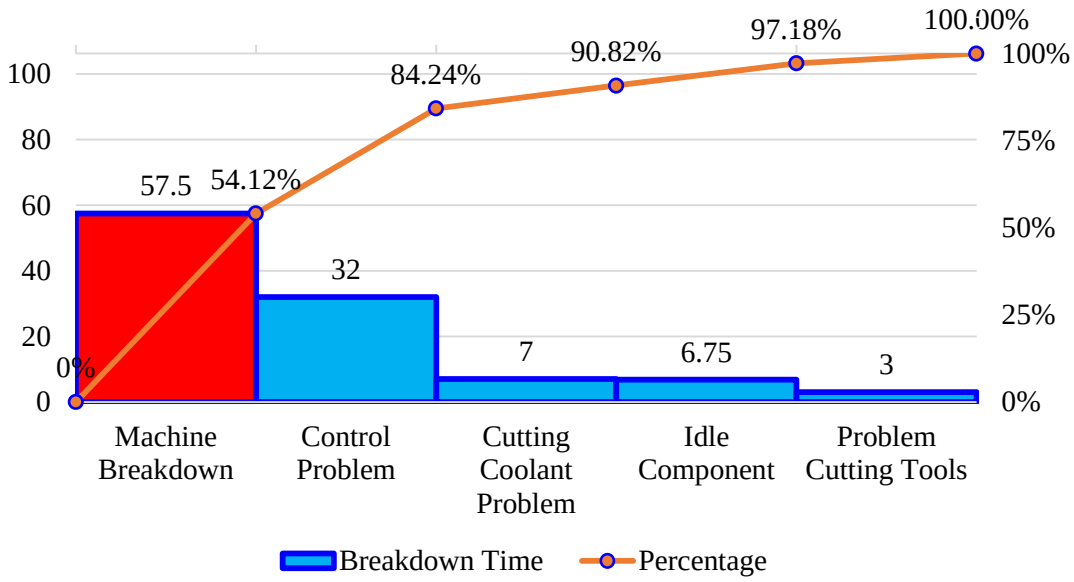

Figure 2. Pareto Reduction Factor OEE SNK HF

3.1 Breakdown Analysis FMEA

The condition of engine damage is the highest factor that causes a decrease in OEE on SNK HF. The following is a detailed analysis of damage related to automatic tool changer, automatic pallet changer, automatic attachment changer and electric control parts using FMEA [16][17].

Table 2. FMEA Assessment Category

Severity		Occurrence		Detection	
Value	**Description**	**Value**	**Description**	**Value**	**Description**
1	No Effect	1	Remote	1	Almost certain
2	Very minor effect	2	Low	2	Very high
3	Minor effect	3	Low	3	High
4	Very low	4	Moderate	4	Moderately high
5	Low downtime or defective parts	5	Moderate	5	Moderately high
6	Moderate downtime or defective parts	6	Moderate	6	Low or no detectability
7	High downtime or defective parts	7	High	7	Very Low
8	Very high downtime or defective parts	8	High	8	Remote
9	hazardous with warning	9	Very High	9	Very remote
10	hazardous without warning	10	Very High	10	Absolute Uncetainty

Table 3. FMEA Breakdown Machine

Problem	Result			
	Severity	Occurrence	Detection	Risk Priority Number
Automatic Tools Changer	5	5	5	125
Automatic Pallet Changer	5	5	5	125
Automatic Attachment Changer	5	5	5	125
Electric Control	8	3	5	120

Table 4. FMEA Spare Parts Category

Type Spare Parts	Result			
	Severity	Occurrence	Detection	Risk Priority Number
Mechanical	4	3	4	48
Electrical	8	3	8	192
Hydraulic	7	3	7	147
Lubrication	8	2	5	80

The OEE condition of the SNK HF engine has not met the 85% JIPM standard [18], the maximum achievement in February 2021 is 82%. The condition of the control panel also needs to be cleaned regularly every 6 months by adding a check point for the cleanliness of the electric control panel so that the condition can be maintained [19][20][21].

4 Conclusion

The OEE condition of the SNK HF engine has not met the 85% JIPM standard, the maximum achievement in February 2021 is 82%. OEE conditions that do not reach the standard are caused by availability below the 95% standard with a maximum achievement of 77.80%. Availability does not reach the standard caused by engine damage that exceeds the time for each standard repair of 3 hours, the actual breakdown exceeds the standard due to the skill of technicians who do not understand the repair of electric control and spare parts that are not available. Suggestions that can be made to increase availability are to prepare critical spare parts so that replacements can be carried out immediately and skill up activities to improve technician analysis skills so that they can find out the root cause of the problem more quickly. The condition of the control panel also needs to be cleaned regularly every 6 months by adding a check point for the cleanliness of the electric control panel so that the condition can be maintained.

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