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To cite this article: Zeny Fatimah Hunusalela *et al* 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **508** 012086

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# Analysis of productivity improvement in hard disc spare parts production machines based on OEE, FMEA, and fuzzy value in Batam

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**Abstract.** Increasing productivity is very important for companies to achieve success in their business processes. The company studied in this study was in Batam, a manufacturing company engaged in the manufacture of plastic products. The purpose of this study was to determine the value of OEE from machines that produce Hard Disc Drive products in order to increase the effectiveness of the machine. Knowing the main root causes that often occurred damage to the machine and to find out how to solve problems that can increase machine productivity. This study uses the Overall Equipment Effectiveness (OEE) and Fuzzy Failure Mode and Effects Analysis methods. The results of the calculation and discussion get the OEE (Overall Equipment Effectiveness) value for April 2018, which is 63.87%. The difference in OEE values obtained is still below the standard value of the OEE classification that makes OEE not reach the target. The main cause of damage to DC machines is 60 tons, namely the low Performance Rate with an average value of 71.71%, this is due to the value of Reduced Speed Losses which has the largest contribution in the six big losses (losses) with a loss of 91.97 the clock which resulted in a DC 60 ton machine not working optimally. The FRPN value of 277 was obtained in the DC 60 ton machine factor so that repairs were needed.

## 1. Introduction

Machine maintenance is one of the important factors for the smooth production process. Because with a good engine performance can produce quality products. But it is often found that repairs or maintenance actions are not right on target with actual problems, such as maintenance in parts that do not occur problems or perform maintenance after a problem occurs. As a result, there are many problems found in a company that the biggest contribution of total production costs is sourced from the cost of carrying out maintenance of equipment, both directly and indirectly

One of the work measurement methods used in measuring the success of TPM is Overall Equipment Effectiveness (OEE). OEE consists of availability, performance, and quality. OEE is a procedure used to determine the effectiveness of a machine [1].



The injection molding process is a dynamic process known for its speed and accuracy when compared to other printing processes [2]. To realize the successful molding injection process and to ensure a strong design of the process, it is important to apply the Failure and Effect.

Analysis Mode (FMEA) [3]. Many studies that use FMEA as a risk analysis technique have shown successful implementation [4]. Failure mode and effects analysis (FMEA) is one of the first systematic techniques that are highly structured for failure analysis [5]. FMEA regulates the principle of identifying and prioritizing possible failures or defects [6]. In the quantification of the risk of PFMEA using indicators (RPN), which are defined as products of severity (S), incidence (O), and detection (D) of failure [7].

The Fuzzy Method, developed to solve problems in parameter descriptions that are subjective, is unclear and inaccurate, is considered as a tool that can directly manipulate linguistic terms used for descriptions of severity, incidence and detection to assess the risks associated with each failure mode.

The researched company is a manufacturing company engaged in the manufacture of plastic products that are inseparable from problems related to the efficiency and effectiveness of the machine, especially in machines that produce Hard Disc Drive products, namely DC 60 Ton machines. The use of machines and production equipment that are not effective can affect product quality. Therefore, machines and equipment require a good and correct maintenance system so as to minimize losses caused by engine damage, use of machinery and equipment.

The OEE value became the initial foundation in this study. The OEE data obtained will be used as a reference to find out how much effectiveness there is in operating the machine. OEE values that are below the global standard for both OEE values and for each factor give an indication of the need to improve the effectiveness of the machine. In order for this improvement to be made it is necessary to first find the most basic cause of any problems that occur during the operation of the machine. The causal factors obtained as a result of identification are some of the problems that have the potential to create losses in the machine, so that these factors must be addressed so that the overall effectiveness of the machine can be improved. And using the Failure Mode and Effect Analysis (FMEA) method and using fuzzy logic. This method has the advantage of being able to prevent or detect earlier than the damage experienced and determine which type of damage should be prioritized.

## **2. Method and Materials**

This research was carried out on a DC 60 ton machine. Data collected in the form of theoretical data and historical data. Theoretical data are in the form of theories about total productive maintenance, overall equipment effectiveness, six big losses, failure mode and effects analysis and fuzzy failure mode and effects analysis. Historical data used is data on equipment damage, equipment operational data and product quality.

## **3. Results and Discussion**

The working time available to the company is 24 hours / day. The company divides working hours into 2 shifts / day, each working shift for 7 hours / day, then the available production time is 840 minutes. Work time data is obtained within a period of one month, that is, April 2018, this data is adjusted to the records obtained from the production department.

OEE calculation analysis is carried out to see the level of productivity of machine use in 60 Ton DC during the period April 2018. This OEE measurement is a combination of time factor, engine operating quality and engine speed. From the calculation results obtained the

value of availability rate 95.63%, performance rate 71.71%, quality rate 94.27% and OEE value 63.87%. This shows that OEE does not reach the company's target.

### 3.1. Calculation Analysis of Six Big Losses Value

Analysis of losses calculation aims to find out the loss factors that provide the biggest contribution in reducing the productivity of DC 60 Ton machines in the company. The percentage that contributes from large to small can be seen in table 1.

**Tabel 1.** Table of Six Big Losses Calculation Results

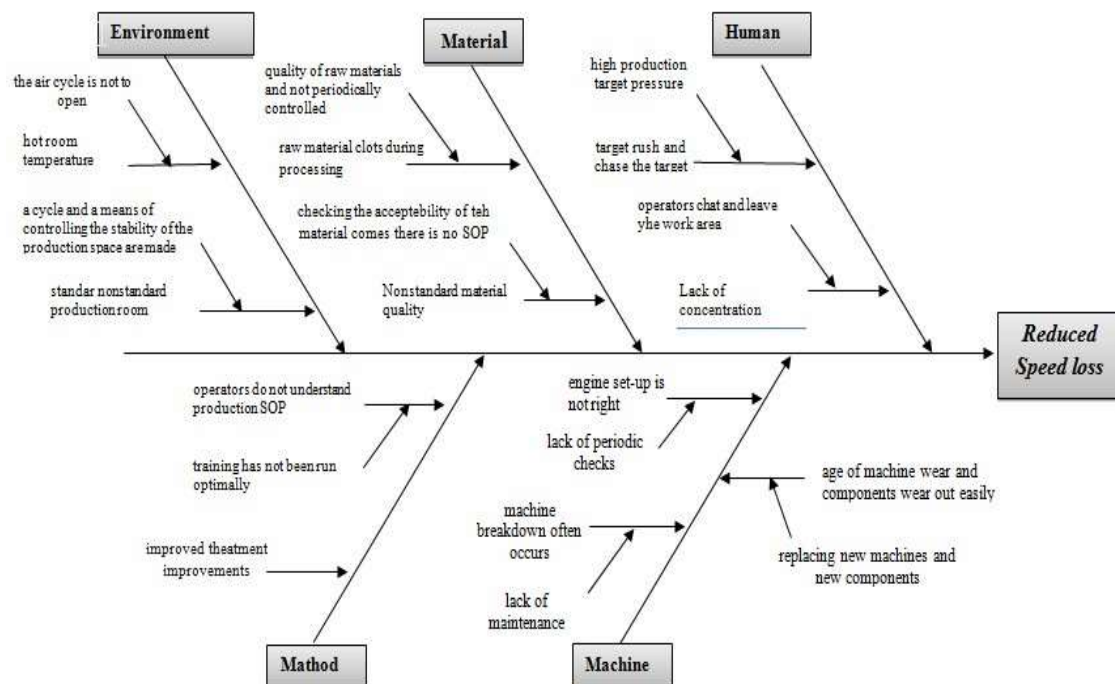
No.	OEE Factor	Big Loss	Total Time Loss (hours)	Percentage %	Cumulative %
1	A	Equipment Failure	12,07	10,12	10,12
		Set up & Adjustment	2,05	1,72	11,84
2	P	Idle and minor stoppage	0,04	0,04	11,88
		Reduced Speed	91,97	77,13	89,00
3	Q	Deffect Losses	13,11	11,00	100,00
		Scrap Losses	0,00	0,00	100,00
Total			119,24	100	

Based on Table 1, it is known that the biggest loss value is in the OEE Performance Rate element, which is Reduced Speed with a value of 91.97 hours or 77.13% which contributes to the main cause of the low DC machine of 60 tons, this shows the low actual speed of the machine making the performance of 60 tons msin DC down due to the large number of products reset during the production process.

The second factor causing losses is the Defect Losses of 13.11 hours or 11.00%. This is caused by the wasted equipment time to produce reject products when the machine runs continuously after adjustment and adjustment processes. Both of these factors led to the target of the production of DC 60 ton machines not being achieved.

### 3.2. Cause and Effect Analysis

The analysis was carried out with the related observations in this study including operators, engineering parts and quality control. The improvement factor of the existing problem is one of the possible causes of the difficulty of achieving the desired OEE target. to obtain the results of the analysis in accordance with the objectives of the study, the data that has been collected is needed in order to facilitate the identification of these things and then the improvements will be formulated to overcome the root causes of further problems. The analysis causes the low factors of the six big losses using a causal diagram (fishbone). Based on the six big losses it is known that the dominant factor causing the low efficiency of the machine is Reduced Speed, Deffect Losses in analyzing researchers conducting interviews with related parties. In Figure 1 shows a causal diagram (fishbone) for the Reduced Speed factor, Deffect Losses.



**Figure 1.** Cause Diagram of Reduced Speed Loss

To speed up the improvement, an analysis of the six big losses that causes Reduced Speed is carried out, Defect Losses uses a fishbone diagram where the largest contribution and has a strong correlation to the decline in OEE is the preparation of equipment and engine disturbances and idling.

### 3.3. Corrective Action Plans to Improve OEE

Fuzzy FMEA is used in this research, especially on DC 60 ton machines because it has the lowest performance value. Data on the causes of disability caused by engine factors obtained from observations and interviews then processed in FMEA calculations. In fuzzy FMEA there are stages in defining fuzzy input functions for severity parameters (S), occurrence (O), detectability (D), evaluation rules by using IFTHEN rules which are obtained into one into fuzzy rules. The IF-THEN rule is then combined so that it becomes a mapping from the fuzzy input to the fuzzy conclusion. De-fuzzy-fication by drawing conclusions is converted into real values that present risks (Mansur & Ratnasari, 2016). The results of the SOD value are then processed using the Fuzzy method. Fuzzy FMEA calculations are detailed in table 2.

**Table 2.** Fuzzy FMEA

Description	Mode of Failure	Cause of failure	Effect of failure	S	O	D	FRPN	Category	Rank
<i>Reduced Speed Losses</i>	The old 60 Ton DC machine, engine breakdown often occurs	Lack of care and checking	Poor engine performance	7	7	8	277	M	1
	The quality of non-standard raw materials, non-periodic control, instability of raw materials that are easily clotted is left.	Lack of checks on raw materials	Raw material is damaged	66	4	5	180	L-M	4
	The lack of concentration of employees chatting out of the work area and operators in working in a hurry due to the pressure of high production targets.	Experience fatigue	Less thorough in paying attention to engine performance	8	7	7	246	L-M	2
	Hot room temperature is not comfortable working conditions, the stability of the room is not standard	Less attention to the comfort of the environment	Operators easily experience eye fatigue	6	3	4	180	L-M	5
	Lack of knowledge of work standards, namely production SOP, lack of maintenance schedule	Lack of checking	The output does not meet the standards	7	7	6	225	L-M	3

Based on table 2, it is obtained the results that in terms of factor of the machine that is 60 Ton DC Machine whose condition is old and engine breakdown often occurs resulting in poor engine performance so that it gets the highest FRPN value of 277, it shows that the machine needs to be repaired. The corrective steps taken to the DC 60 Ton engine maintenance system are availability availability, the equipment of production machines used in production activities is very important. The machine used must not experience long damage because it will interfere with the course of the production process and will greatly affect work productivity. The steps to overcome the problems associated with the engine are: Provide lubricating oil / gear grease chain on the motor drive, calibrate the pressure pressure under standard conditions, schedule replacement of equipment that will be damaged and worn before breakdown, checking routinely pipes/hoses so that there is no leakage and makes a regular preventive maintenance schedule.

#### 4. Conclusion

Based on the results of the analysis of the research carried out on DC 60 Ton machines, it can be concluded that the average OEE value in April 2018 around 63.87% shows that it is still below the standard OEE value of 85% so that it requires an increase or improvement of the system to increase the value OEE especially in performance values. The main cause of damage to DC machines is 60 tons, namely the low Performance Rate with an average value of 71.71%, this is due to the value of Reduced Speed Losses which has the largest contribution in the six big losses (losses) with a loss of 91.97 the clock which resulted in a 60 ton DC engine not working optimally. From the FRPN results, the highest value is on the engine factor of 277, namely the 60 Ton DC machine is old and often has a breakdown. So that it needs to be repaired by checking routinely on the pipe / hose so that there is no leakage and make a regular schedule for preparation.

## 5. References

- [1] Dutta, S., Dutta, A. K. 2016. A Review on the experimental study of Overall Equipment Effectiveness of various machines and its improvement strategies through TPM implementation. *International Journal of Engineering Trends and Technology (IJETT)* – Volume 36 Number 5, pp 224-232.
- [2] Vijayakumar, S. Gajendran, R., S. 2014. Improvement of Overall Equipment Effectiveness (OEE) In Injection Moulding Process Industry. *National Conference on Contemporary Approaches in Mechanical, Automobile and Building sciences-2014*, IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), PP 47-60.
- [3] Randelović, S., Mladomir, M., Nikolić, S., Kačmarčík, I. 2015. Risk Assessment In Injection Molding Process. *Journal for Technology of Plasticity*, Vol. 40 (2015), Number 2, PP 23-34.
- [4] Wessiani, N. A., Yoshio, F. 2017. Failure mode effect analysis and fault tree analysis as a combined methodology in risk management. *International Conference on Industrial and System Engineering (IConISE) 2017*, IOP Conf. Series: Materials Science and Engineering 337 (2018) 012033, PP 1-11.
- [5] Tripathi, S., Jain, S. 2017. Study of the Product Failure Modes and Effects Analysis (PFMEA) on Welding Process- A Implementation Paper. *International Journal of Innovative Research in Science, Engineering and Technology*, Vol. 6, Issue 5, PP 7991-7996.
- [6] Shivakumar, K. M., Hanumantharaya, R., Mahadev, U. M., Kiran, P. A. 2015. Implementation of FMEA in Injection Moulding Process. *International Journal of Engineering Trends and Technology (IJETT)* – Volume 22 Number 5- April 2015, PP 230-235.
- [7] Rachieru, N., Belu, N., Anghel, D. C. 2013. Improvement of Process Failure Mode and Effects Analysis using Fuzzy Logic. *Applied Mechanics and Materials* Vol. 371 (2013), PP 822-826