ANALYSIS OF MILLING MACHINE MAINTENANCE SYSTEM USING FMECA METHOD CASE STUDY ON CV. GRAND MANUFACTURING INDONESIA

Ilham Nuswantoro[1], I Made Aryantha Anthara[2]
Program Studi Teknik Industri, Universitas Komputer Indonesia, Bandung
Jl Dipatiukur No. 112-116, 40132, Tlp. (022) 2504119, Fax. (022) 2533754
Email: ilhamnuswantoro22@gmail.com[1] i.made.aryantha@email.unikom.ac.id[2]

ABSTRACT

Along with the increasing development of the production process, the company generally focuses on making the product continuously. The production process will affect the productivity condition of a company, be it machine and operator. Declining productivity indicators are related to the maintenance of the company's production facilities. Treatment is an activity to take care of company facilities, in this case machine. Well-maintained machine is certainly very helpful for companies to produce products optimally, both from quality and quantity.

This research was conducted at CV. Grand Manufacturing Indonesia. The problems raised in this research is about the maintenance process or maintenance of the machine that has not been optimal, which is caused because the existing procedures or methods are not running properly. Existing care only focuses on checking, cleaning of machinery, repairing or replacing broken parts and changing oil. This will affect the machine easily damaged or the reliability of the engine will be reduced and the performance of the machine will not be optimal.

This research uses Failure Mode Effects and Criticality Analysis (FMECA) method. This study aims to identify the damage experienced by the machine, to find the cause and effect caused by the breakdown of components and to identify adverse effects that will occur if the machine is damaged. In this research is done according to procedure of method used.

From research conducted in CV. Grand Manufacturing Indonesia, by using FMECA method can be known critical components that occupy the priority in the treatment action, namely the fan belt and cutter components. The damage experienced by these two components is broken and worn out. From the results of this study is expected the company can know the engine damage and able to perform better repair actions.

Keywords: RPN (Risk Priority Number), Failure Mode Effects and Criticality Analysis.

1 Introduction

Along with the increasing development of the production process, the company generally focuses on making the product continuously. The production process will affect the productivity condition of a company, be it machine and operator. Declining productivity indicators are related to the maintenance of the company's production facilities. Treatment is an activity to take care of company facilities, in this case machine. Well-maintained machine is certainly very helpful for companies to produce products optimally, both from quality and quantity. Maintenance management is a method to avoid problems to machines that can interfere with the continuity of the production process. Efficient and effective production activities will be accomplished through well-run maintenance management.

CV. Grand Manufacturing Indonesia is a filter oil production company. Type of machine used in CV company. Grand Manufacturing Indonesia is Pons machine and Milling machine. Pons machine function is to cut a variety of materials such as sieves with the help of Pon blades that are operated without using electrical energy or manually. The Milling machine function itself is a machine tool for working on or completing workpieces using a knife and is not spared from damage. Therefore, the researchers chose Milling machine as a critical machine because it often suffered damage weighed Pons machine, then Milling machine requires routine inspection and maintenance in order to operate properly and the maximum and safety of the user can be guaranteed.

Common problems that often faced by this company is about the process of maintenance or maintenance of machinery that has not been optimal, which is caused by the existing procedures or methods are not running properly. The treatment is still standard, ie only cleaning the machine and repairing or replacing the engine components when damaged and oil change only. This will certainly make a machine will be easily damaged and the reliability of the machine will not be maintained properly. Damage to the machine itself is certainly caused from the components of the machine that is often or continuously damaged and the cause is clearly no good maintenance measures undertaken by the company to deal with the problem.

2 Study of Literature

2.1. Maintenance

Maintenance is the activity so that broken components or systems will be reversed or corrected in a certain situation at certain period of time. (Supandi, 1999)

2.2. Basic Concept of Care

Treatment is a conception of the origin of all activities expected to maintain or maintain the quality of the equipment in order to be permanently functioning using both as in the preceding terms. (Supandi, 1999)

2.3. Maintenance Management

Treatment is a method used for activities in planning, organizing, directing, and supervision of production machines and supporting machinery. Definition of maintenance means an activity for maintaining or maintaining facilities, machinery and equipment factory and held a restoration or replacement is required so that a situation that can be used can be operated production satisfactory sync using what is required. (Ebeling, 1997)

2.4. Reliability

Reliability is as the probability of a performance system that fits the function needed in a given period of time. Basically reliability as a measure for the ability of a component that operates continuously, precautionary measures taken so as not to increase the reliability of the system. (Ebeling, 1997)

2.5. *Failure Mode, Effects and Criticality Analysis* (FMECA)

"In the implementation of this method is very good in helping the company because with this method the company can identify the damage of engine components, looking for causes and potential consequences caused and other adverse effects and also can perform actions that should be done according to the procedures or methods of FMECA itself. With the FMECA method the company can regularly perform the maintenance procedures of the machine, so that sudden damage to the system or machine can be overcome. FMECA is also a method to identify and examine how to avoid damage or failure of the system, whether the damage caused by the operator (man), machine, material and also the environment." (Blanchard, 1994)

3 Results and Discussion

3.1 Determination of the Most Critical Milling Machine Component

The following is data collected obtained from the report of maintenance activities of machines from 2016 to 2017 which can be seen in table 3.1. below this:

Table 3.1. Selected Critical Component Data

No	Component Name	Frequency of Damage	Type of Damage
1	FAN BELT	12	Break
2	SPESER RODA GIGI	4	Worn out
3	CUTTER	9	Worn out
4	PIN SPINDLE	4	Broken
5	GEARBOX	3	Worn out
6	MESIN PENGGERAK	1	Engine off
7	TUAS DRILL	1	Worn out

The comparison charts for determining critical components can be shown in the figure below:

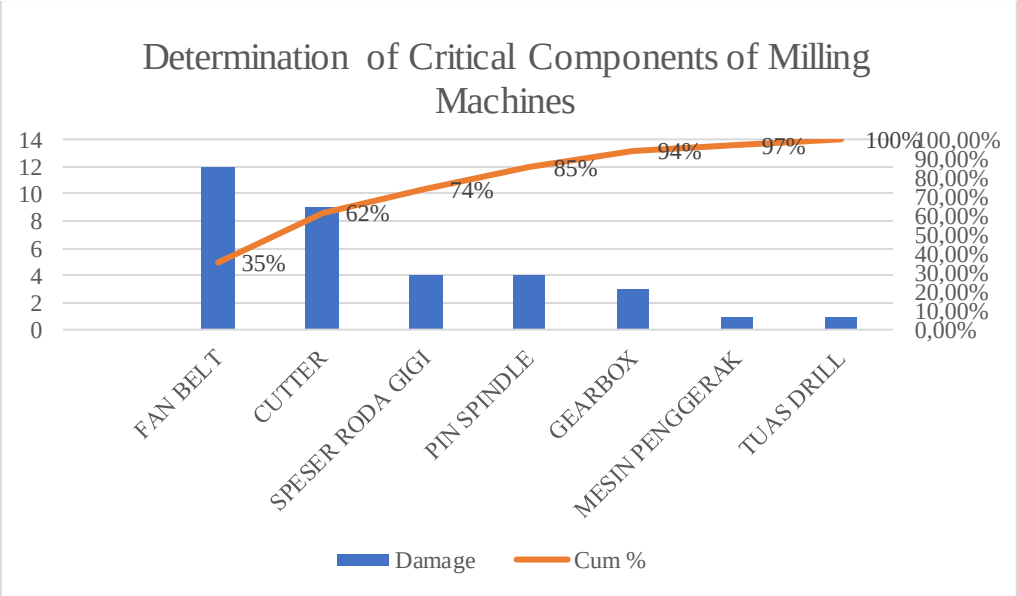


Figure 3.1. Pareto Diagram Determination of Critical Components of Milling Machines

3.2 Determine the Causes and Effects of Critical Components

The following causes that affect the damage of the components Fan belt and Cutter can be seen in Figure 3.2. and 3.3. below this:

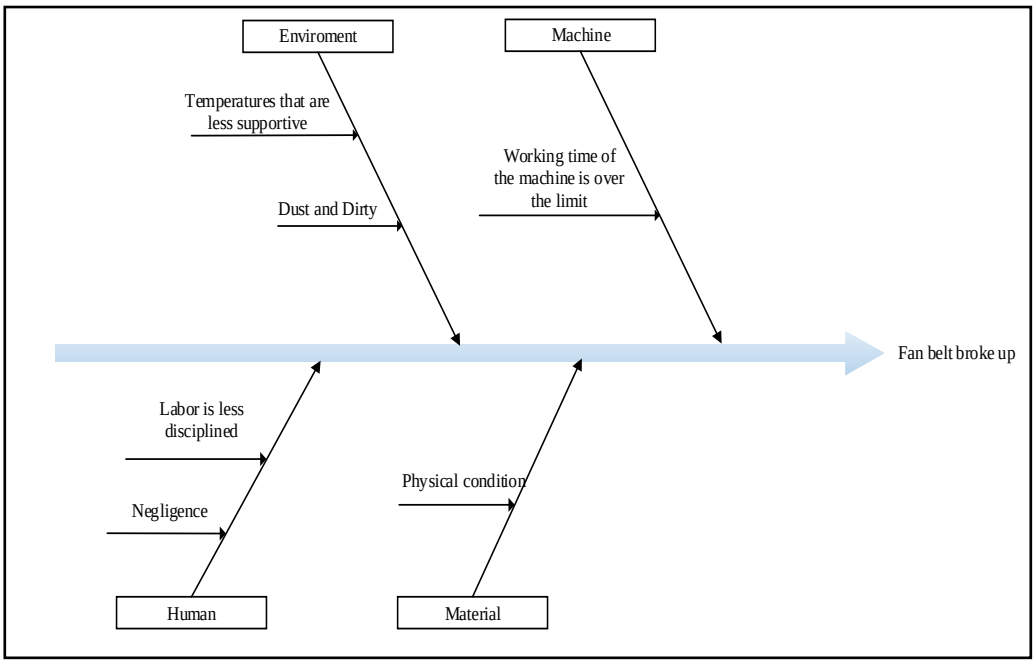


Figure 3.2. The Cause and Effect Diagram of the Fan Belt Component

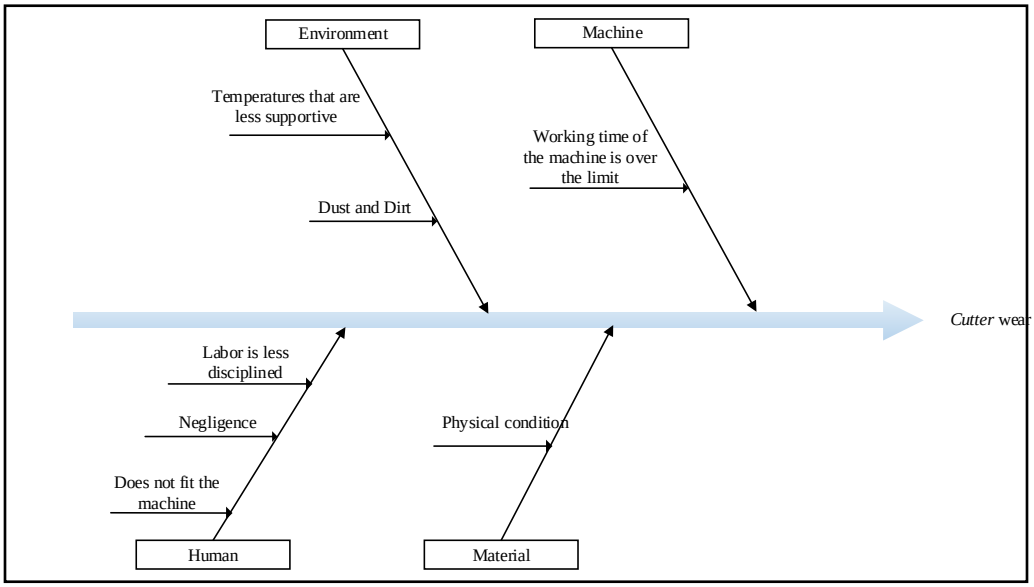


Figure 3.3. The Cause and Effect Diagram of the Cutter Component

The following is an assessment of the kind of damage that the process can be seen in Table 3.2. below this:

Table 3.2. Level of Damage Against Process Of Critical Components

Component Name	Ugliness to Process	Level
Fan belt	Very high; Due to the degree of ugliness when this type of damage happens very fatal.	10
Cutter	High; Because the resulting product is not precision or not according to customer wishes that make consumers dissatisfied.	8

3.3 Assess Frequency of Event Type of Failure

The following frequency of failure events of a critical component provides an overview of a system that is often damaged. The frequency of failure types of these critical components can be seen in the following table:

Table 3.3. Frequency Rate of Event Type of Failure of Critical Components

Component Name	Frequency of Event Type of Failure	Damage Probability	Level
Fan belt	Very high; Damage that can hardly be ignored / left out.	12 times in 1 year	10
Cutter	High; Repeated damage.	9 times in 1 year	8

3.4 Assess Probability Detection

Assessing the probability of damage from critical components is a design or procedure for detecting potential types of damage at the appropriate time in the system. The assessment of probability detection for each critical component can be seen in the following table :

Table 3.4. Level of Probability Detection Of Critical Components

Component Name	Probability Detection	Level
Fan belt	*Absolute certainty of nondetection*; Can not detect any type of potential damage.	10
Cutter	High; Detects potential types of damage	3

3.5 Calculating RPN (Risk Priority Number)

RPN is the value used to determine which component has the highest priority for the maintenance action. RPN can be known by the equation as follows :

Table 3.5. Risk Priority Number (RPN) For Each Critical Component

Priority	Component Name	Ugliness to Process	Frequency of Event Type of Failure	Probability Detection	*RPN*
1	Fan belt	10	10	10	1000
2	Cutter	8	8	3	192

3.6 Worksheet FMECA

Here is the worksheet FMECA can be seen in the table below:

Table 3.6. FMECA Worksheet Of Milling Machine Components

Cause

System : Production — Failure Mode Effect and Criticality Analysis — FMECA number : 01

Sub system : Milling Machine — Component Machine Milling

Component : Fan belt and *Cutter* — Key Date : 31/01/2018

Component Name	Results of Hope Function	Damage	Cause of Damage	Effect (in funtion; from user view)	Detection	*Severity*	*Occurrence*	*Detection*	RPN	Recommended Action
Fan Belt	Fan belt works in accordance with its lifetime	Break	- Working time of the machine is over the limit - Physical condition - Temperatures that are less supportive - Dust and dirt - Labor is less disciplined - Negligence	No products were produced	Engine off	10	10	10	1000	Checking and maintenance of this component more attention.
Cutter	Cutter works in accordance with its lifetime	Worn out	- Working time of the machine is over the limit - Physical condition - Temperatures that are less supportive - Dust and dirt - Labor is less disciplined - Negligence - Does not fit the machine	The machine keeps working but the resulting product is not precise / not standardized	The product is not precise	8	8	3	192	Maintenance of this component is more routine again in order to control the wear.

4 Conclusion

4.1 Conclusion

Further describes the conclusions of the results of the analysis of the previous chapter.

1. By doing this research as well as processing data that has been done, then Milling machine component which in critical condition, that is component of Fan belt and Cutter. The determination of this critical machine component is based on the results of comparison with the Pareto diagram. Can be seen from the frequency of damage occurred Fan belt 12 times and Cutter as much as 9 times in the bracket time of 1 year backward.
2. From the result of determination of causal factor of damage (fishbone), got factor that influence to component damage caused by four factors that are machine, material, environment and human factor. But the method factor is not used because the company is already using standard operating procedures. The main cause of damage to the fan belt component is from the engine factor due to the working time of the machine that exceeds the usage limit. Three factors supporting the damage that is the material factors caused by the physical condition of the product, environmental factors caused by temperatures / temperatures that are less supportive and dust and dirt, human factors caused by operator less discipline and negligence.
3. Based on the results of the RPN (Risk Priority Number) calculation, the critical component that occupies the priority in the maintenance action is the fan belt that has a value of 1000 and the cutter 192.

4.2 Suggestion

The following are suggestions put forward in this study:

1. We recommend that companies apply FMECA maintenance methods to identify Milling machine damage.
2. In conducting further maintenance and repair, the company should make a change that occurs without having to wait for components of the machine until it is damaged.
3. We recommend that the company make an environmental change where the environment is more supportive of the maintenance process.

5 References

[1] Badriah Nurlailah, Sugiarto Dedy, Anugerah Chani. (2016). *PENERAPAN METODE FAILURE MODE EFFECT ANALYSIS (FMEA) DAN Expert System (SISTEM PAKAR).* Jurnal Online Universitas Trisakti.

[2] Blanchard, Benjamin S. (1995). Maintainability. Dinesh Verma, Elmer L. Peterson.

[3] Ebeling, Charles. (1997). *An Introduction to Reliability and Maintainability Engineering*. Singapore, The MC. Graw Hill Companier Inc, New York

[4] Jardine, A.K.S. (1973). *Maintenance, Replacement and Reliability*, Department of Engineering Production Universitas of Birmingham.

[5] *Maintenance Excellence*. (2001). New York: John D. Campbell.

[6] Supandi. (1999). *Manajemen Perawatan industri*. Bandung, Ganeca Exact Bandung.