

Maintenance Preventive Scheduling of Critical Components in Offset Printing Machine (Case Study : PT. XYZ)

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ABSTRAK

Maintenance activities are generally considered as supporting activities in the production process. However, this activity is very important because it contributes directly to the smooth running of the production process and productivity. PT. XYZ is a company engaged in mass media or newspapers since September 8, 2015. In the newspaper production process, PT. XYZ experienced delays in the production process due to damage to the component parts of the printing machine, in which the Offset printing machine is the core printing machine that is always used to print newspapers. Based on data on the frequency of damage during 2020 which was obtained from observations and interviews with operators, damage to machine components for 1 year on the offset printing machine counted 73 times that it was damaged. Thus making the machine stop operating from the effective working time of the machine, which is 264 days/year. This is due to the unavailability of a machine maintenance schedule because the company is still implementing a breakdown maintenance system. Thus the researcher aims to calculate the value of the identified critical components and calculate the effective time of machine operation for scheduling replacement of critical components of offset printing machines using the Reliability Centered Maintenance method. Based on the results of data processing using the Reliability Centered Maintenance method, the contactor component is determined as a critical component where the value of the Risk Priority Number is 72 with an average checking time of 11,250 minutes and component replacement time of 7 times/year. For this reason, it can be concluded that the contactor is a critical component with a

damage value of 72 and the scheduling time for component replacement is 7 times in 1 year.

Keywords: RCM, Scheduling, FMEA, RCA, Contactor, RPN.

1. INTRODUCTION

Maintenance activities are generally considered as supporting activities in the production process. However, this activity is very important because it contributes directly to the smooth running of the production process and productivity. Therefore, if maintenance is planned properly, then the condition of the machine will always be good and ensure the smooth production process in the company. In addition, a good engine condition will also affect the quality of the product output.

Companies are increasingly relying on machines to produce goods. The machines used are physical assets that require maintenance so that the company continues to be productive. Since the industrial revolution era, industrial care has produced several treatment theories and treatment models. In the past, machine maintenance used a breakdown maintenance system, where maintenance was carried out after a breakdown occurred. Then machine maintenance developed with a preventive maintenance system. According to Ebeling (1997), preventive maintenance is maintenance that is carried out on a scheduled basis, generally periodically. Preventive maintenance aims to prevent sudden engine damage, increase reliability, and can reduce downtime (Assauri, 2008).

Based on data on the frequency of damage during 2020 which was obtained from observations and interviews with operators, damage to machine components for 1 year on the offset printing machine

DOI : <https://doi.org/10.36456/tibuana.4.02.4012.110-119>

counted 73 times that it was damaged. Where the damage to parts of the printing machine components consists of electrical components and mechanical components. Electrical components such as relays are damaged 9 times/year, contactors are damaged 9 times/year, Paper Sensors are damaged 7 times/year. Meanwhile, the Roll Air mechanical component was damaged 15 times/year, Blengket was damaged 13 times/year, Paper Suction Rubber was damaged 20 times/year. Thus making the machine stop operating from the effective working time of the machine, which is 264 days/year. This is due to the unavailability of a machine maintenance schedule because the company is still implementing a breakdown maintenance system. In the event of a breakdown, the operator only performs the usual maintenance and repairs, such as the replacement time, which is only done for cleaning. Damage that occurs suddenly can disrupt the production schedule which has been planned. Therefore, it is proposed to maintain the machine with using a preventive maintenance system.

2. METHODS

2.1 Understanding Machine Maintenance

Machine maintenance is an activity carried out to maintain and maintain a machine or equipment by seeking repair or replacement of damaged components so that it always remains in a condition ready to be operated properly until production can run smoothly according to plan.

The function of maintenance will be felt when the system starts to experience disturbances and can no longer operate. With regular maintenance, it is hoped that operational bottlenecks due to equipment damage can be avoided.

2.2 Damage

A machine or equipment can be said to be damaged if the machine cannot perform its function properly. The cause of damage to a machine, one of which is human nature (human error) who does everything outside the rules that should be, including operating a machine.

Damage to a machine will usually cause losses for the company due to the cessation of the production process to make machine repairs. To avoid this, it is very important for the maintenance or maintenance to design a schedule to find out the cause of the damage.

2.3 Offset Printing Machine

Offset printing machine is a printing machine that comes from Tokyo Japan. A printing machine that uses a master or is called a plate with a process transfer letters to Blanket. Because the price is quite expensive, this tool is usually intended for printing business only. For printing in large quantities, it is recommended to use this machine, because the cost is cheaper than using a digital printing machine.

For the components themselves, the offset printing machine consists of 5 main units, namely the Plate Cylinder, Blanket Cylinder, Impression Cylinder, Ink Cylinder and Water Cylinder.

2.4 Reliability

This reliability is closely related to the design / design of the tool / component of the machine / system. Where the reliability of a system (eg a car) depends on the reliability of the components that make up the engine (eg: propulsion devices, safety devices, brakes, etc.). This reliability has never reached 100% (no/no failure/damage). Where the level / degree of damage () that occurs will vary as shown in Figure 1.

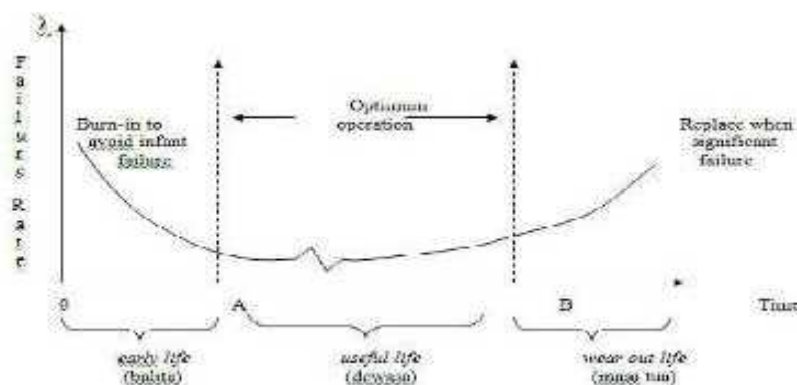


Figure 1. Machine Reliability

2.4 Reliability Centered Maintenance (RCM)

There are many forms of RCM definitions from various sources, but the main goal is to maintain system function by identifying the failure mode and prioritizing the importance of the failure mode and then selecting effective and applicable preventive maintenance actions.

It is hoped that RCM can present a framework based on reliability information for efficient, effective and capable planning as the best choice in the adjustment and development of optimal treatment models. The planning also includes predicted and recommended replacement components.

2.5 Failure Mode and Effect Analysis (FMEA)

FMEA (Failure Mode & Effect Analysis) is a risk analysis and mitigation technique developed at the US Aeronautics and Space Administration (NASA) in the early 1950s and later popularized in the automobile industry to prevent defects in process and design. In the last decade, the use of FMEA has spread to various industries which are used to achieve success in process development. FMEA is a system for researching a process, designing a product or service system to identify potential failures, then acting to neutralize or minimize the risk of these failures.

According to Sharma et al. (2007), the main objective of FMEA is to find and

prioritize potential failure modes by calculating each RPN, where the product is occurrence, severity and detection.

2.6 Cause and Effect Diagram

This diagram is useful for analyzing and finding factors that have a significant or significant effect on determining the quality characteristics of work output. In addition, this diagram is useful for finding the real causes of a problem.

Diagrams related to 4M are also called fishbone diagrams because they look like fish (Cause and Effect Diagrams). In addition, it is also called the Ishikawa diagram because the one who discovered it was Prof. Ishikawa from Japan. This diagram is used to identify the cause of a problem so that data collection and further analysis can be carried out.

Madu (2005) in Sharma et al. (2007) classify the causes related to 4M namely man, machine, material and method thereby helping to establish basic knowledge related to product or service problems as well as in the process.

3. RESULTS AND DISCUSSION

3.1 Production System PT. Maina

Manawa Perkasa

In producing newspaper products, PT. Maina Manawa Perkasa requires two main things to be able to produce, namely raw materials, printing machines and equipment which will be explained below.

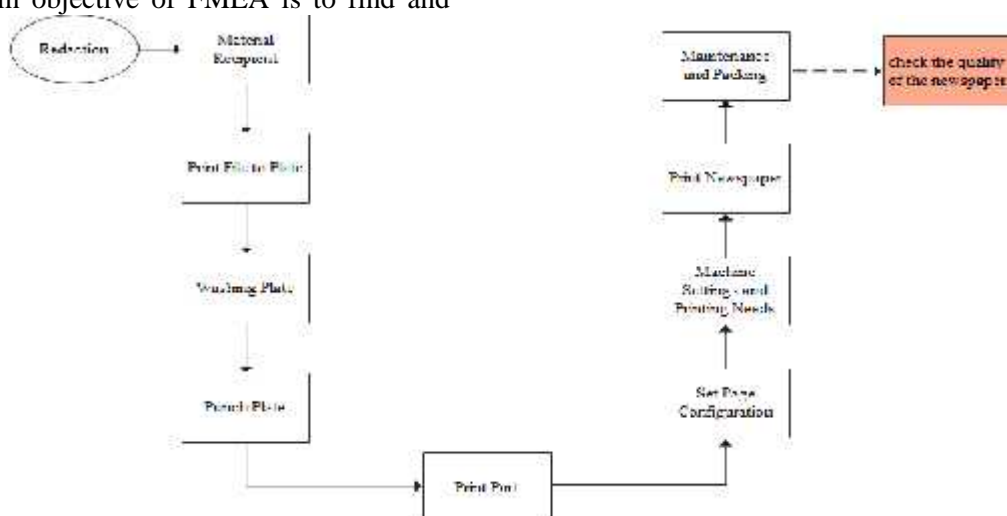


Figure 2. Newspaper Production Process

3.2 Factors That Cause Damage To The Offset Printing Machine

1. Lack of knowledge from operators on how to use and properly care for Offset printing machines.
2. No technician for special maintenance of Offset printing machine.

3. No schedule for machine maintenance.

3.3 Damage Time Analysis

Table 1 describes the time data for machine component damage for 1 year on the Offset newspaper printing machine as follows:

Table 1. Damage Frequency Data 2019

Number	Component	Damage Frequency
1	Reley	9 times/year
2	Contactora	9 times/year
3	Paper Sensor	7 times/year
4	RollAir	15 times/year
5	Blengket	13 times/year
6	Paper Suction Rubber	20 times/year

3.4 Analysis Using The Reliability Centered Maintenance Method (RCM)

1. System Selection and Information Collection

Overall the system on the Offset machine has input, process, and output. The input of this system is plain paper which is

flowed from the rollstand machine, then enters the process of giving ink to the writing and images in red, blue, etc., and the output of the Offset machine is paper that already contains news in the form of long sheet. Table 2 below shows the processing time of the production machine.

Table 2. Production Machine Processing Time

Machine	Start Engine	Time off
Printing MachinePlate	3 hours/day	30 minutes
Plate Folding Machine	3 hours/day	30 minutes
Roll Stand Machine	3 hours/day	30 minutes
Offset Machine	3 hours/day	30 minutes
Folder Machine	3 hours/day	30 minutes

2. System Constraint Definition

The printing process is the final process of the production process at PT. Maina Manawa Perkasa has 1 newspaper printing machine (Offset) and 4 machines supporting the printing process. At the printing unit of PT. MMP in one day, the Offset machine is operated for 3 hours from start of working time until the product is ready for distribution.

Offset Printing Machine at PT. MMP has the components of a newspaper printing machine and the working principle while the focus of the research study is only on the Offset newspaper printing machine so that the working principle of the printer is as follows:

- a. Mechanical components are components that function in the mechanical printing process. In the mechanical component there are 5 main components, namely:
 - Water Roll
 - Blengket
 - Paper suction rubber
- b. Electrical components are supporting components that function as a liaison between 1 and other components. In the electrical component there are 3 main components, namely:
 - Relay
 - Contactora
 - Paper sensor

3. System Description and Functional Block Diagram

System descriptions and block diagrams are representations of the main functions of the system in the form of blocks containing the functions of each subsystem that composes the system. As is known, the

function of the Offset machine is a very important function, because this machine plays a role in providing ink to the writing and images on newsprint which determines the quality of the printouts of newspapers, which can be seen in Figure 3.

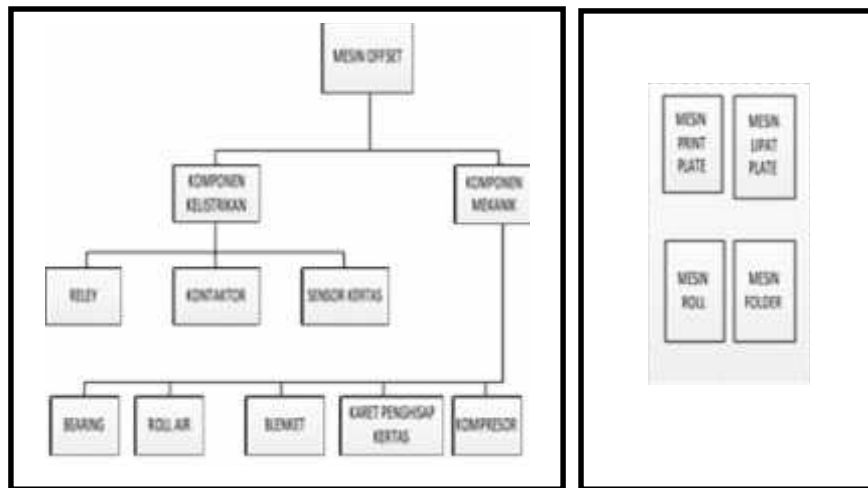


Figure 3. Functional block diagram

4. System Function and Functional Failure

In the process of producing newspapers at PT. Maina Manawa Perkasa goes through 3 stages where there are input, process and output where in this process the causes of production failure or damage to production machines can be classified as follows:

- a. Machine life factor

- b. Human resource factor
- c. Factors unavailability of machine maintenance schedule.

5. Failure Mode and Effects Analysis (FMEA)

The following is a failure mode and effect analysis for electrical components with 3 components:

- a. Electrical Components with Relay components

Table 3. Failure Mode And Effect Analysis For Relay

System	:	Offset Printing Machine							
Sub System	:	Electrical Components							
Component	:	Relay							
No Component	:	1							
Function	Potential Failure Mode	Potential Of Effect Failure	SEV	Potential Failure Mechanism	OCC	Design Control	DET	RPN	Recommended Action
1	2	3	4	5	6	7	8	9	10
Run and operate all machine components	Damage to Relay	Machine not working normally	2	The machine can still be operated	2		8	32	Replace contactor

DOI : <https://doi.org/10.36456/tibuana.4.02.4012.110-119>

- b. The contactor has the ability to automatically connect and disconnect the electric current as well as a power control circuit on the printing machine.

Table 4. Failure Mode And Effect Analysis For Contactor components

System	:	Offset Printing Machine							
Sub System	:	Electrical Components							
Component	:	Contactor							
No Component	:	2							
Function	Potential Failure Mode	Potential Of Effect Failure	SEV	Potential Failure Mechanism	OCC	Design Control	DET	RPN	Recommended Action
1	2	3	4	5	6	7	8	9	10
As a liaison and breaker of electric current automatically	Damage to contactor	Machine not working normally	8	The machine cannot be operated	3		3	72	Replace contactor

- c. The Paper Sensor functions as a paper detection device when the paper enters the printing machine or plate cylinder.

Table 5. Failure Mode And Effect Analysis For Paper Sensor Components

System	:	Offset Printing Machine							
Sub System	:	Electrical Components							
Component	:	Paper Sensor							
No Component	:	3							
Function	Potential Failure Mode	Potential Of Effect Failure	SEV	Potential Failure Mechanism	OCC	Design Control	DET	RPN	Recommended Action
1	2	3	4	5	6	7	8	9	10
Paper detector when the paper enters the printer or plate cylinder	Paper sensor malfunction	Machine not working normally	1	The machine can still be operated	1		9	9	Replace paper sensor

From the results of the RPN calculation, there are 3 components that have the highest index value, namely the contactor with an RPN value of 72, and the relay value of RPN 32. While the other 1 component has a very minimal RPN value so that prioritized on electrical components are 2 components that have the largest RPN value.

Mechanical components are parts that function for and are separated from the

electrical components in this tool, there are 3 components :water rolls, blengket, paper suction rubber, and compressors.

- a. The water roller is a mechanical component that functions as a tool that produces clean, clear prints (writing and images) and also functions to drain water into the water reservoir.

Table 6. Failure Mode And Effect Analysis For Water Roller Components

System	:	Offset Printing Machine							
Sub System	:	Mechanical Components							
Component	:	Water Roll							
No Component	:	1							
Function	Potential Failure Mode	Potential Of Effect Failure	SEV	Potential Failure Mechanism	OCC	Design Control	DET	RPN	Recommended Action
1	2	3	4	5	6	7	8	9	10
As a means of determining the printout, writing is clean and clear	Damage to the ink roller due to tearing	Writing is not clean and clear	5	The machine can still be operated	2		3	30	Replace water roller

b. Blengket is a mechanical component that functions to print and regulates so that prints do not occur imagining both writing and images, damage to

this tool can cause writing or images on newspapers to be shadowed and unclear.

Table 7. Failure Mode And Effect Analysis For Blengket Components

System	:	Offset Printing Machine							
Sub System	:	Mechanical Components							
Component	:	Blengket							
No Component	:	2							
Function	Potential Failure Mode	Potential Of Effect Failure	SEV	Potential Failure Mechanism	OCC	Design Control	DET	RPN	Recommended Action
1	2	3	4	5	6	7	8	9	10
Print and set the text not to shadow	Damage to the blengket	Text and images don't reflect	4	The machine can still be operated	2		7	56	Replace the blengket

c. Paper suction rubber is a mechanical component that functions as a tool to pull paper. Damage to this tool can

cause the production process to stop temporarily due to paper snagging.

Table 8. Failure Mode And Effect Analysis For Paper Suction Rubber Components

System	:	Offset Printing Machine							
Sub System	:	Mechanical Components							
Component	:	Paper suction rubber							
No Component	:	3							
Function	Potential Failure Mode	Potential Of Effect Failure	SEV	Potential Failure Mechanism	OCC	Design Control	DET	RPN	Recommended Action
1	2	3	4	5	6	7	8	9	10
Tool for pulling paper	Damage to the paper suction rubber	Paper is not attracted so the production process stops temporarily	4	The machine can still be operated	5		3	60	Replace the paper sucker

From the results of the RPN calculation, there are 2 components that have the highest index value, namely paper sucking rubber with an RPN value of 60, and a stick with a value of RPN 56. While the other 1 component has a very minimal RPN value so that mechanical components are prioritized, namely 2 components that have a value largest RPN.

3.5 Critical Components of Determination

Determination of critical components using a Pareto chart because of all component damage will cause the Offset engine to stop. The offset machine will be repaired or replaced. The pareto chart is made by collecting data on unplanned downtime regarding component damage that occurs in the Offset machine which is obtained from the daily report of the Offset machine.

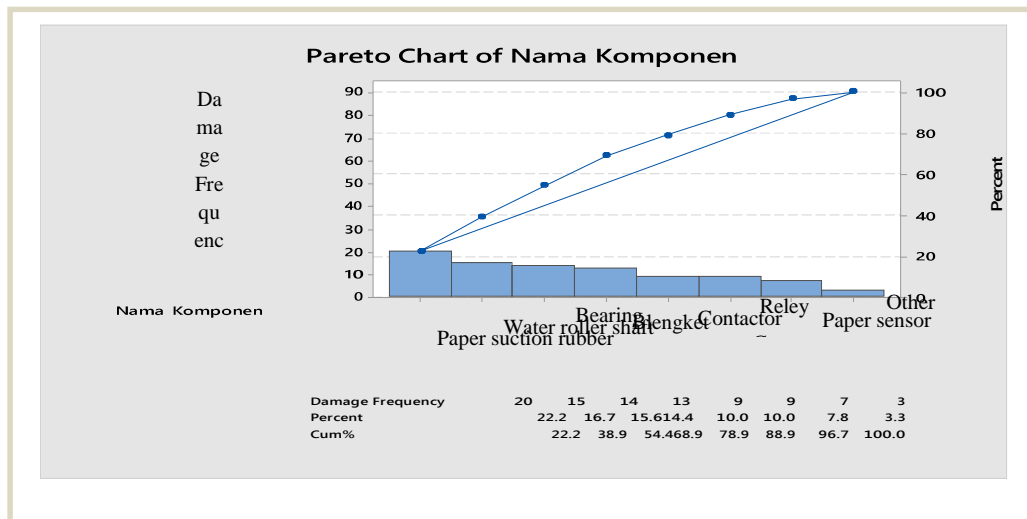


Figure 4. Pareto Chart Of Offset Engine Critical Components

The results of the Pareto chart in Figure 4 can be seen that the biggest damage to the paper sucker rubber component is 22.2%. Component damage that occurs in the Offset engine occurs in eight components. The eight critical components need to be

repaired first in an effort to increase the availability and reliability of the Offset machine.

3.6 Offset Engine Critical Component Reliability Analysis

Reliability calculations are used on offset machines which are lognormally distributed for a time interval (t) of one day, with known values, namely scale (s) 12.6872 and median (t_{med}) 10.9162 are as follows:

$$R(t) = 1 - \varphi\left(\frac{1}{s} \ln \frac{t}{t_{med}}\right)$$

$$= 1 - 3,14\left(\frac{1}{12,6872} \ln \frac{3}{10,9162}\right)$$

$$= 1 - 3,14(0,0788 \ln 0,2748)$$

$$= 1 - 3,14(0,0788(-1,2917))$$

$$R(t) = 0,2176$$

3.7 Critical Component Predictive Maintenance Scheduling

In this study, the company actively produces 264 effective working days with 792 hours of work for one year. The replacement period for the contactor components on the machine within one year that must be carried out by the company with a proposed replacement for 10.9162 hours is $792 : 10.9162 = 7.25527$ or 7 times/year.

From the results of data processing above, it is known that the average time between damage to contactor components occurs every 792 hours/33 days, which means the company must replace or maintain components every 792 hours, this is intended so that the machine is always ready to carry out the production process. Meanwhile, the average time between repairs or component checks that must be carried out by the company is every 11 minutes.

3.8 Cause And Effect Diagram

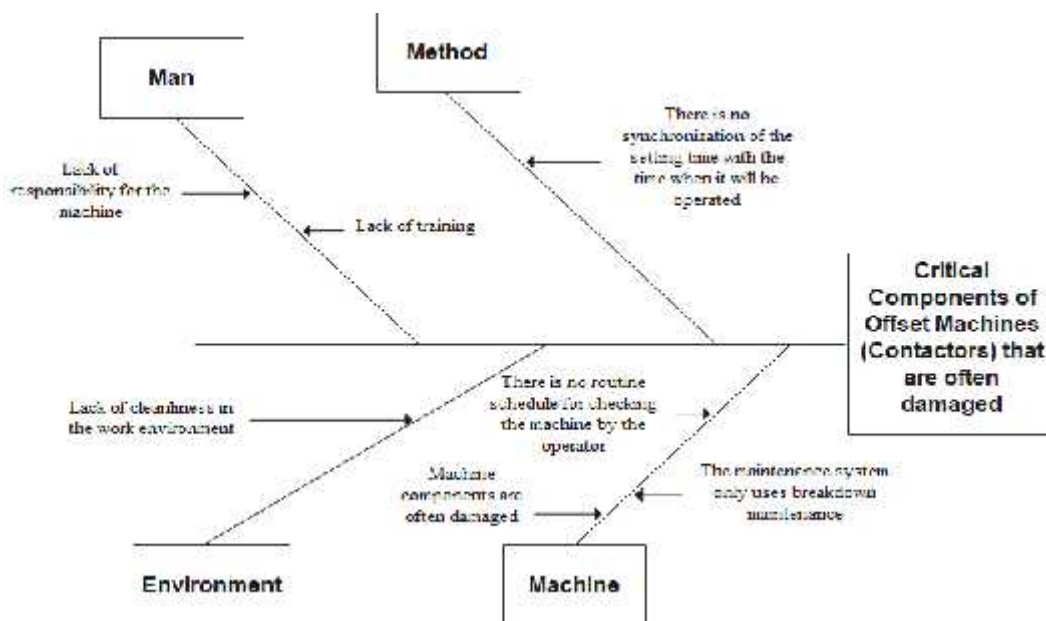


Figure 5. Fish Bone Diagram

This diagram is useful for analyzing and finding factors that have a significant or significant effect on determining the quality characteristics of work output. In this case, it was found that the critical component of the offset machine was found that the largest

critical component was the contactor component. the critical component of the offset machine, it was found that the largest critical component was in the contactor component.

4. CONCLUSION

The conclusions obtained are as follows:

1. Based on the results of qualitative analysis using failure mode and effect analysis (FMEA) to determine the critical components of the offset machine, it was found that the largest critical component was in the contactor component. The contactor has the ability to automatically connect and disconnect the electric current as well as a power control circuit on the printing machine. on the table4 the operator gives a severity value of 8 and occurrence 3 because the probability of damage is moderate. The operator can detect the cause of the failure so that the detection column is given a number 3. Then the RPN value on this component is $RPN = S \times O \times D = 8 \times 3 \times 3 = 72$, indicating that if there is damage it can turn off the system so that the machine cannot be operated. So that the contractor is determined as a critical component
2. While it is known that the average time between damage to contactor components occurs every 792 hours/33 days, which means the company must replace or maintain components every 792 hours, this is intended so that the machine is always ready to carry out the production process. From the results of data processing using minitab software, it is known that the data is close to a lognormal distribution with shape value = 2.43784 and scale value = 12.6872 with an average checking time of 11 minutes and component replacement time 7 times/year.

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