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To cite this article: N Sembiring *et al* 2018 *IOP Conf. Ser.: Mater. Sci. Eng.* **309** 012127

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The engine maintenance scheduling by using reliability centered maintenance method and the identification of 5S application in PT. XYZ

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Abstract. PT. XYZ is a manufacturing company that produces fresh fruit bunches (FFB) to Crude Palm Oil (CPO) and Palm Kernel Oil (PKO). PT. XYZ consists of six work stations: receipt station, sterilizing station, threshing station, pressing station, clarification station, and kernelery station. So far, the company is still implementing corrective maintenance system for production machines where the machine repair is done after damage occurs. Problems at PT. XYZ is the absence of scheduling engine maintenance in a planned manner resulting in the engine often damaged which can disrupt the smooth production. Another factor that is the problem in this research is the kernel station environment that becomes less convenient for operators such as there are machines and equipment not used in the production area, slippery, muddy, scattered fibers, incomplete use of PPE, and lack of employee discipline. The most commonly damaged machine is in the seed processing station (kernel station) which is cake breaker conveyor machine. The solution of this problem is to propose a schedule plan for maintenance of the machine by using the method of reliability centered maintenance and also the application of 5S. The result of the application of Reliability Centered maintenance method is obtained four components that must be treated scheduled (time directed), namely: for bearing component is 37 days, gearbox component is 97 days, CBC pen component is 35 days and conveyor pedal component is 32 days While after identification the application of 5S obtained the proposed corporate environmental improvement measures in accordance with the principles of 5S where unused goods will be moved from the production area, grouping goods based on their use, determining the procedure of cleaning the production area, conducting inspection in the use of PPE, and making 5S slogans.

1. Introduction

PT. XYZ is one of the companies engaged in processing oil palm. Based on preliminary observations, companies often experience machine breakdown issues. Where the production machine is most often damaged is the cake breaker conveyor machine. This can hamper the production process which has an impact on the decrease in production capacity. PT. XYZ applies two maintenance systems namely corrective maintenance and planned maintenance [1]. Maintenance can be divided in two types: corrective and preventive maintenance. Corrective maintenance means that machine or component need a repair work, is done after a breakdown or when obvious failure has been found. Corrective maintenance as its best should be applied in non-critical machine where consequences of failure are slight ,rapid failure repair are possible, consequences of failure are slight, capital costs are small, and



quick failure identification. Preventive maintenance is intended to minimize the probability of failure or degradation of functioning of a component, to carried out predetermined intervals.

In corrective maintenance repair is done when there is damage to engine and planned maintenance, maintenance is done by scheduling every one week. Other problems faced by the company are the environment conditions that are less convenient for operators such as slippery, muddy, and scattered (fiber) strewn conditions like this can hamper production activities where if the fiber fell into the engine area, the engine can be damaged like a broken CBB pen . Therefore the application of 5S is required in this study in addition to using RCM method. Problems of PT. XYZ is basically can be overcome by trying to propose a machine maintenance system using Reliability Cantered Maintenance (RCM) method. Defining the maintenance schedule and knowing the appropriate maintenance tasks that must be performed on every damaged component of the machine are done by the RCM method. And to overcome the problem of working environment needed an improvement method [2].

As a procedure to applied preventive maintenance in a complex system, Reability Centered Maintenance has been known and applied in many industrial field. Such as railway network, steel plant, ship maintenance or aviation. The countries applying RCM include Japan, Britain, The United States, etc [3]. The RCM methodology performs a structured and applied approach for achieving a satisfactory maintenance strategy for each part of a RCM system is an methodology that all of the management level concern, care, and preventive an maintenance strategies and practices in an integrated procedure to increase the probability that a machine or component will function as its design with minimum maintenance [4]. Any companyhave benefit from RCM if its breakdowns frequencies for more than 20-25% of the total system maintenance [5].Research on maintenance that apply Reliability Centered Maintenance ever done and poured in a journal entitled "Proposed Planning Machine Care with Reliability Centered Maintenance (RCM) Method at PT. Perkebunan Nusantara VII (Persero) Business Unit River NiruKab. Muara Enim. 2012, Asisco Hendro, et al [6]. And also research Evi Febrianti, et al with title "Proposed Planning Care Machine Roughing Stand with Approach Reliability Centered Maintenance. 2016" [7].Srinivasan et al. (2016) have analysed that 5S implementation can influence effectively by improving management and employee commitment, communication, work environment , priority of safety, management appreciation of risk , towards achieving improvement in productivity by optimizing space utilization, inventory ratio and minimizing cycle time [8]. The manufacturing management should follow up certain procedures which are comfortable to implement in order to achieve high level of improvement in performance indicators. So managers, consultants, and HR executives are conducted and build a strong team to utilize the effectiveness of management principles [9]. P.3SEM5S has emerged as a simplified and smooth tool for eliminating the waste and non-value added activities in the LM process to bring continuous improvement in an organization's performance [9]

2. Research Methods

Research begins with the review and data collection at PT. XYZ. Data collected from company documents are damaged machine components, damage interval data, damage frequency, and breakdown time of cake breaker conveyor machine. While observation of environmental condition of company conducted by observation directly in field. Reliability Centered Maintenance method is used to determine maintenance schedule of critical machine components. This method begins with System selection and information collection, Defines system boundaries, System description and function block, Descriptions of system function and malfunction, Failure Mode and Effect Analysis (FMEA), Logic Tree Analysis (LTA), Action Selection. After doing the next step RCM is testing the data distribution of each component, so the parameters obtained for the calculation of Reliability and MTTF. The above steps are performed to get the appropriate maintenance schedule for each broken machine component. The final step of this research is to provide suggestions for improvement of the company's environmental conditions.For the environment in PT XYZ would applied the 5S method, which is the method of structuring and maintaining the work area will improve workers' discipline and

create a safe and comfortable working environment for all workers with support of all management level.

3. Results and Discussion

3.1. Steps of RCM

The first step in solving the problem of research results is by performing RCM steps. This method begins with System selection and information collection, Defines system boundary, System description and function block, Descriptions of system function and malfunction, Failure Mode and Effect Analysis (FMEA), Logic Tree Analysis (LTA), Action Selection. The flowchart of RCM steps can be seen in Figure1.

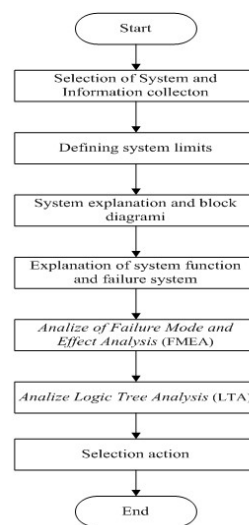


Figure 1. Steps of RCM

3.2. Distribution Test

The distribution test is performed on the components included in the Time Directed (TD) action selection. These four components are also critical components of the conveyor cake breaker machine. The results of the distribution test can be seen in Table 1.

Table 1. Distributions Test

NO	Name of Components	Distribution
1	<i>Pen CBC</i>	Normal
2	<i>Pedal conveyor</i>	Normal
3	<i>Gearbox</i>	Logormal
4	<i>Bearing</i>	Weibull

Based on Table 1, the pattern of damage distribution depends on the interval of component damage over a certain period.

3.3. Recapitulation Reliability and Mean Time to Failure (MTTF)

After knowing the distribution's type of critical component, the next step is recapitulation, reliability and MTTF critical component as shown on Table 2.

Table 2. Recapitulation Reliability and MTTF Critical Component of Cake Breaker Conveyor Machine

Name of Components	Reliability	MTTF
<i>Bearing</i>	0,4698	37,6776
<i>Gearbox</i>	0,4150	97,401
<i>Pen CBC</i>	0,4821	35,6429
<i>Pedal</i>	0,4834	32,7647
<i>Conveyor</i>		

Based on Table 2 can be known reliability and MTTF each component of cake breaker conveyor machine that is damaged. So that companies can apply preventive maintenance schedule based on research that has been done with the aim to reduce the engine breakdown time.

3.4. Maintenance Schedule of Critical Components

The maintenance schedule of cake breaker conveyor machine components is obtained based on Mean Time to Failure (MTTF) and based on the parameters of each selected distribution. Maintenance of critical machine components that often experience failure mode on cake breaker conveyor machine can be seen in Table 3.

Table 3. Maintenance Schedule of Components Machine

NO	Name of component	Maintenance Schedule (Days)
1	<i>Pen CBC</i>	35
2	<i>Pedal conveyor</i>	32
3	<i>Gearbox</i>	97
4	<i>Bearing</i>	37

Based on Table 3 the maintenance schedule of the critical machine component becomes the basis of the company's consideration in making the calendar of repair schedule or the replacement of machine components in one year. Substitution of components is done before the damage occurs so as to reduce the downtime of the conveyor cake breaker machine. Actual care system is still corrective and planned maintenance, with the maintenance schedule of the machine is obtained a preventive treatment.

3.5. Proposed Improvement of the Work Environment with the 5S Implementation

Improving the working environment by applying the 5S principle is expected to provide comfort and security for operators at work so as to increase work productivity and avoid work accidents.

For implementation 5S in PT XYZ there are some of the procedure:

1. Top management involvement initiatives such as provide resources for supporting 5S as a continuous improvement initiatives, communicate and educate its employees about mission statement and strategy, demonstrate the business vision, strategy and implementation plan to the employees, procedural hassles in the administrative work identified and consistently reviewed to improve various support functions.
2. Employee involvement initiatives such as training to regard 5S and other quality control tools for understanding/solving problems, consistently evaluated and efforts made to improve the skills from time to time, motivate to participate in continuous improvement initiatives.

Implementation of preventive maintenance will not be expected to prevent the occurrence of damage to the machine but only reduce the number of machines damaged. Here is an example calendar maintenance schedule cake breaker conveyor machine in July 2017

Jul-17						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

Figure 2. The Schedule of Maintenance

The preparation of the engine maintenance calendar in figure 2 is based on the MTTF value of each machine component. On the maintenance calendar specified the date of machine components that must be repaired or replaced. The color giving of the treatment calendar aims to distinguish the components to be treated. The purple color symbolizes the gearbox component, the green color symbolizes the conveyor pedal components, while the yellow color symbolizes the CBC pen component.

4. Conclusion

The critical component maintenance schedule based on the research result is bearing component is 37 days, gearbox components 97 days, 35 day CBC pen component and 32 day conveyor pedal components. Improvement of the company's work environment is done by proposing improvements with the implementation of 5S. After identifying the application of 5S, the proposed corporate environmental improvement actions are in accordance with 5S principles where unused goods will be transferred from the production area, grouping goods based on their use, determining the production area cleaning procedure, conducting ongoing inspection on the use of PPE, and creating a slogan. Slogan 5S should be keep in mind that the implementation of preventive maintenance will not be expected to prevent damage to the machine but only decrease the number of defective machines

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