SPINNING MACHINE MAINTENANCE SCHEDULING AND COST PLANNING UNIT USING MARKOV CHAINS METHOD AT ARGO PANTES

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ABSTRACT

Smoothness and success of the production process is largely determined by the conditions of production machinery and support equipment. This study focuses on the process of spinning unit that functions as a unit of spinning cotton into yarn, based on the results of AHP according three experts who responsible for carding machine where the machine failures often occurs due to less than optimal maintenance. In addressing these issues the company needs to do an evaluation of engine maintenance activities, it takes planning for engine maintenance at the carding process, including control activities, repair and replacement of spare parts using Markov chain. The results showed that the maintenance of the company cost about Rp 284 605 484. while the maintenance costs after using Markov chain Rp. 170 891 389. resulting in a savings of USD 77714.095 or by 31%. It is proved that the method of Markov chain can indeed be used to minimize the cost of maintenance of machines - machines in the company. Planning preventive maintenance on the machine carding process proposed is preventive maintenance on the engine type finitex performed every 2 months, to the type of machine meikin performed every 2 months, to the type of machine nitto performed every 2 months, to the type of machine CN performed every 2 months, of the kind crossroll engine performed every 1 month.

Keywords: Probability, Maintenance, Costs, Machines

1. INTRODUCTION

Productivity of a machine can be seen from the use of machinery and equipment support, optimally in its use. In particular production process used machines continuously, for it is necessary to the maintenance of the machine. PT. Argo Pantes Tbk is one of the manufacturers of fabrics that are marketed to manufacturers of apparel manufacturer, one of its products is the thread. This study focuses on the process of spinning unit that functions as a unit of cotton spinning into yarn.

Such care could include corrective maintenance, preventive maintenance running and maintenance. The maintenance will affect the cost of downtime and maintenance costs of preventive maintenance or preventive maintenance activities have a fairly high maintenance costs. In terms of usability, the engine maintenance system requires a best method so that machines can minimize the spinning unit of the frequent occurrence of the damage, by organizing activities as early as possible and engine maintenance done regularly which includes control, an improvement over the existing damage and replacement components make the production run smoothly and engine maintenance planning can increase productivity by reducing damage to the smallest engine.

Based on the results of the third AHP process experts who have problems on the machine that is the carding process in which the damage often occurs due to less than optimal maintenance. To overcome the problems faced by the company, this research did the application Markov chain method to solve the problem in the hope can be done on a regular machine maintenance planning and organized so that the production process can run smoothly and reduce the cost of maintenance on the carding process.

2. THEORETICAL BACKGROUND

This study will be conducted with several theories about the maintenance.

Maintenance (Sofyan Assauri, 1999) is an activity to preserve or maintain plant equipment and facilities or conduct made repairs or replacement are needed so there is a satisfactory state of production operations in accordance with what was planned. Such care could include corrective maintenance, preventive maintenance running and maintenance. The maintenance will affect the cost of downtime and maintenance costs of preventive maintenance or preventive maintenance activities have a fairly high maintenance costs.

Of theories that have been mentioned on the measurement of productivity, Markov chain is one method of engine maintenance. Markov chain is a method that study the properties of a variable in the present which is based on its properties in the past in an attempt to assess the properties of the same variable in the future (P Siagian, 1987).

3. RESEARCH METHODS

This study begins by making the identification of problems that occur is to formulate the problem, set goals, determine the limits and assumptions of the problem. The next step is to collect the data, the data collected from the type and number of machines, change the status of the machine, time machine maintenance and engine maintenance costs. Once the data is obtained, this data can be processed to be arranged in a matrix of Markov Chain.

3.1 Determination Of Machines Maintenance

Conduct a brainstorming to experts regarding the selection process of spinning neediest machines maintenance system based on AHP method.

3.2 The Transition Probability Matrix Calculation Machine

a. Maintenance Company Current Conditions, namely:
- Corrective Maintenance on the status 4 (P0)

b. Maintenance Proposed namely:
- Maintenance of the status of the four corrective and preventive maintenance on the status of 3 (P1).
- Corrective Maintenance on the status 3 and 4 and preventive maintenance on the status 2 (P2).
- Corrective Maintenance 4 status, preventive maintenance on the status of 2 and 3 (P3).
- Corrective Maintenance on the status 3 and 4 (P4).

3.3 Maintenance Cost Calculations

The calculation of the cost of maintenance company then from the five wisdom maintenance Markov chain method, would have been the wisdom that has an average cost of the lowest expectations.

$P_0 = \pi_1 + \pi_2 + \pi_3 + \pi_4$ (corrective maintenance costs) .....(1)

$P_1 = \pi_1 + \pi_2 + \pi_3$ (preventive maint costs) + π_4 (corrective maint costs) .....(2)

$P_2 = \pi_1 + \pi_2$ (preventive maint costs) + π_3 (corrective maint costs) + π_4 (corrective maint costs) .....(3)

$P_2 = \pi_1 + \pi_2$ (preventive maint costs) + π_3 (corrective maint costs) + π_4 (corrective maint costs) .....(3)

$P_3 = \pi_1 + \pi_2$ (preventive maint costs) + π_3 (preventive maint costs) + π_4 (corrective maint costs) .....(4)

$P_4 = \pi_1 + \pi_2 + \pi_3$ (corrective maint costs) + π_4 (corrective maint costs) 2) .....(5)

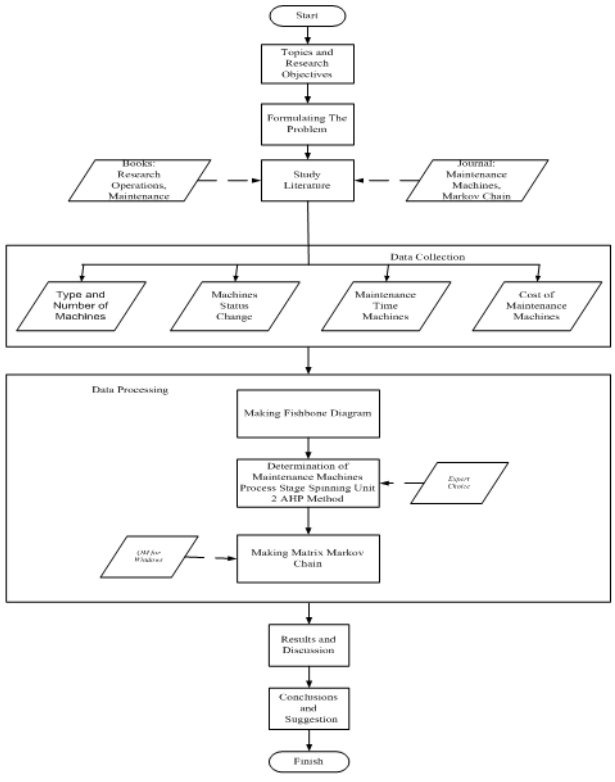

Figure. 1 Flowchart of Research

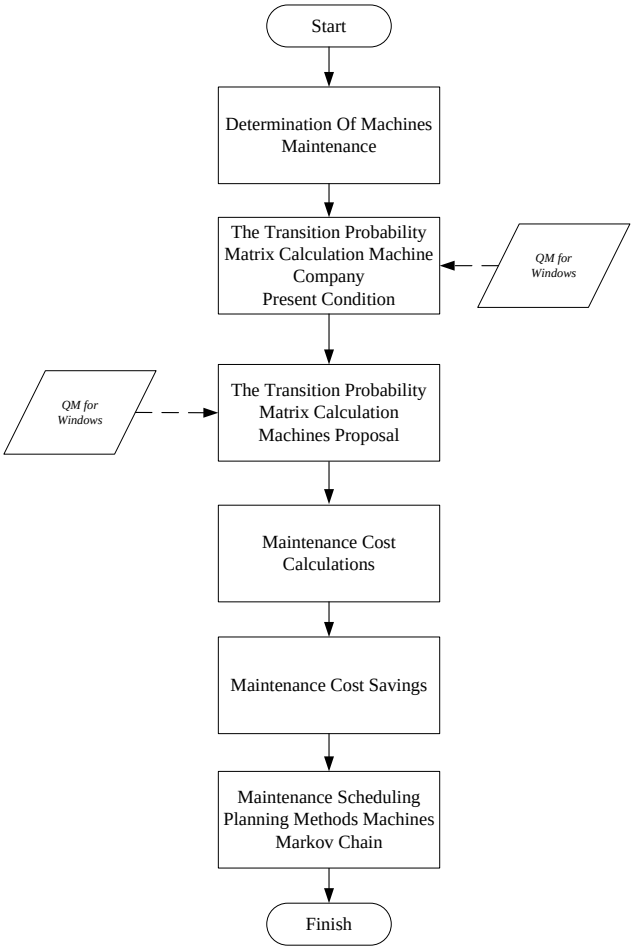

Figure 2. Stages Markov Chain Method

4. RESULTS AND DISCUSSION

4.1. Cause and Effect Diagram

Figure 3 is a fishbone diagram created based on direct observation and brainstorming with the employees who are directly involved in the activities of spinning process:

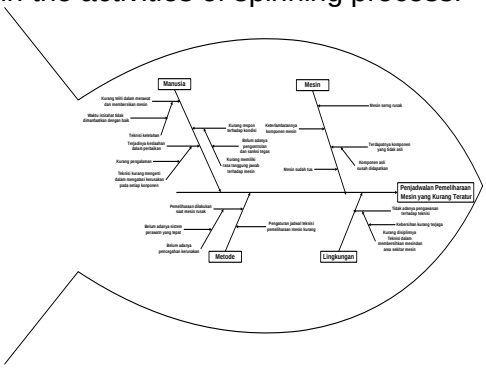

Figure 3. Diagram Fishbone Cause Scheduling Maintenance Machines Less Organized

4.2. AHP

In helping to prepare this study, in collaboration with the three experts to fill out a questionnaire that had been prepared beforehand. Here is a list of the experts:

1. Mr Sumardi: Head of Department
2. Mr. Mursid: Head of Production Home
3. Mr. Yunus: Rear Head of Production

After brainstorming and discussion, the authors making a hierarchical structure in accordance with the problems that have been obtained from the results of the discussion. The criteria used are the criteria relating to machines maintenance system, namely the production, the amount of damage to machines, machines maintenance costs. Hierarchical structure of the selection process is spinning at Argo Pantes Tbk can be seen in Figure 4:

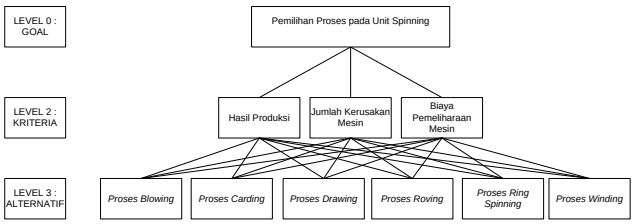

Figure 4. Structure of AHP Hierarchy

The combined results of AHP calculation with Expert Choice software in 2000, it was found that the selection process of the spinning units are most in need of system maintenance is the process of carding machines with weights 0299, while the highest criterion is the yield by weight of 0461 because the process is not the achievement of production, the amount of damage machines quite a lot, and a big enough machines maintenance costs. Where this election is the first step that must be done to improve machines maintenance system using Markov chain method. Inconsistency value obtained was 0.01 which means <0.1, then the third expert assessment conducted are consistent.

4.3. The Transition Probability Matrix Calculation Current Conditions Company Production Machines

Transition probability matrix company current state (P0) maintenance on heavy damage condition (state 4) to determine the

probability of long-term steady state for each machines, in determining the steady-state probabilities using QM software for Windows. Transition probability matrix company current state (P0) as follow:

Table 1. The transition probability matrix Company Current Conditions Production Machines

Maintenance Activities	Probability P_0			
	Good	Small	Medium	Weight
Finitex	0.3054	0.1922	0.0989	0.2689
Meikin	0.2952	0.1962	0.188	0.2608
NITTO	0.2923	0.1995	0.1428	0.2372
CN	0.3096	0.1948	0.1621	0.255
Crossroll	0.5699	0.1037	0.1451	0.1814

In Table 1. the results of the steady-state probability machines using QM software for windows where P0 is the corrective maintenance activities on the condition of severe damage (status 4). Opportunities machines in good condition, slightly damaged machines odds, chances are damaged machines, and opportunities were severely damaged machines. Stadey state on the machine finitex π1, π2, π3 and π4 equal to 1 then in a state of equilibrium.
Machines maintenance activities carried out by using a probability matrix machines, after all probability matrix inserted into the machines QM software for windows based on each proposal will be displayed on the attachment sheet. Here are the results of the calculation of the steady state probability of the proposed P1, P2, P3, and P4 using the software QM for Windows (Table 2)

4.4. Maintenance Cost Calculation

The average cost of corrective maintenance company expectations the current state (maintenance of the status 4) using markov chain method.
The total cost of maintenance company current conditions
= machines meikin finitex + machines + machines + machines nitto CN + machines crossroll
= Rp 57,221,920 + Rp 84,829,547+ Rp Rp 46,855,188 + 52,397,480 + Rp 7,301,350
= Rp 284,605,484
The total cost of maintenance proposal
= machines meikin finitex + machines + machines + machines nitto CN + machines crossroll
= Rp Rp 65,407,633 + 34,295,500 + 36,472,270 + Rp Rp Rp 31,401,801 + 3,314,185 = Rp 170,891,389

Table 2. Results Steady state probability Each Machines Proposed by QM Software for Windows

Types Of Machines	Maintenance Activities	Probability			
		Good	Small	Medium	Weight
Finitex	P_1	0.2128	0.379	0.1439	0.1727
	P_2	0.4403	0.1849	0.0564	0.116
	P_3	0.4174	0.2288	0.0535	0.1099
	P_4	0.3403	0.2322	0.115	0.161
Meikin	P_1	0.2522	0.3217	0.0937	0.2229
	P_2	0.4271	0.1726	0.0556	0.1492
	P_3	0.4052	0.2165	0.0527	0.1415
	P_4	0.3342	0.2221	0.0855	0.2098
Nitto	P_1	0.2128	0.379	0.1439	0.1727
	P_2	0.4403	0.1849	0.0564	0.116
	P_3	0.4174	0.2288	0.0535	0.1099
	P_4	0.3403	0.2322	0.115	0.161
CN	P_1	0.2487	0.308	0.0993	0.2082
	P_2	0.5443	0.2321	0.0675	0.1561
	P_3	0.5099	0.2806	0.0632	0.1462
	P_4	0.3632	0.2323	0.0967	0.2074
Crossroll	P_1	0.5314	0.2094	0.0902	0.1691
	P_2	0.7586	0.1104	0.069	0.0621
	P_3	0.7097	0.1678	0.0645	0.0581
	P_4	0.6667	0.1212	0.0848	0.1273

4.5. *Maintenance Cost Saving*

After reviewing the cost of maintenance on the current state of the company's condition on the Moon April 2013 - March 2014 to the overall production of carding machines are identified, and the average cost of maintenance expectations proposed using Markov chain at steady state in April 2013-March 2014 for overall production carding machines identified. Then the maintenance cost savings as follows in Table 3.

Table 3. Maintenance Cost Savings

Maintenance Cost Savings	Total Cost of Maintenance	Savings (of this Company Current Conditions)	Saving (%)
Maintenance Costs Current Conditions Company (Ab_1)	79,248,340	-	-
Expectations Maintenance Fee Proposal (Ab_2)	-	79,248,340	100%

Because Ab_2 (maintenance proposed using Markov Chain Method) < Ab_1 (maintenance company at present), so maintenance proposed using Markov chain method is

more effective and efficient can be used and accepted, then need to be considered again by the management company.

4.6. Maintenance Scheduling Planning Methods Machines Markov Chain

Maintenance damage production machines consisting of machines finitex, meikin machines, machines nitto, CN machines, and machines crossroll on condition of con dition company is currently in the first year it takes over 426 hours total time obtained from the sum of the corrective maintenance, for 139 hours obtained from the sum of the total time of preventive maintenance. In addition, require maintenance costs Rp 248,605,484 with 12 months for 1 year.

Maintenance of production carding machines identified for the current condition of the company's condition and maintenance of the proposed method Markov chain for one year requires the following:

= (Σ proposed maintenance costs) / (Σ rill maintenance costs) x time corrective maintenance

= 170 891 389/248 605 484 x 426 = 292.83 hours ≈ 293 hours

So the maintenance of the machines took over 293 hours and maintenance costs amounting to Rp 170,891,389. By scheduling maintenance planning as follows:

Table 4. Maintenance Scheduling Planning

Types Of Machines	Machines Maintenance Scheduling (Hours)	Machines Maintenance Scheduling (Months)
Finitex	69	2
Meikin	82	2
Nitto	65	2
CN	61	2
Crossroll	19	1

5. CONCLUSION

Based on the analysis by using a fishbone diagram, it can be concluded the cause of machines maintenance scheduling on a less regular spinning process, namely the Human (break time is not utilized properly, yet the presence of control and strict sanctions against the performance of technicians, less experience), Environment (lack of oversight of technicians), methods of work (lack of proper maintenance method, technician scheduling is still lacking), Machines (delay engine components, the presence of components that are not genuine, old machines).

Average costs - average expectations of maintenance methods current state companies to prevent damage to the total maintenance cost Rp 284 605 484 and 170 891 389 markovRp chain method. The cost savings from the proposed planning no month April 2013 - March 2014 amounting to Rp 77714.095 or by 31%.

Preventive maintenance on machines type finitex done every 2 months, preventive maintenance on machines type meikin performed every 2 months, preventive maintenance on machines type nitto performed every 2 months, preventive maintenance on machines type CN done every 2 months, preventive maintenance on machines type crossroll performed every 1 month.

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