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COST ANALYSIS OF CORN MILLING MACHINE MAINTENANCE (A STUDY AT CV MANDIASIH TABANAN)

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Abstract

Maintenance costs are costs incurred from maintenance activities performed by a company. High maintenance costs may reduce the company's profitability. Selecting an appropriate maintenance strategy aims to improve the efficiency of maintenance cost utilisation so that maintenance costs can be reduced, thereby increasing profitability. This study aims to identify the most appropriate machine maintenance strategy based on the costs incurred under two alternative maintenance strategies, namely the Corrective Maintenance Policy and the Preventive Maintenance Policy, for the corn milling machine owned by CV Mandiasih. This research was conducted at CV Mandiasih, Tabanan. This study employed a quantitative descriptive research design. The sampling technique used was total sampling, with the research sample consisting of one corn milling machine owned by CV Mandiasih. The study utilised both qualitative and quantitative data obtained from primary and secondary sources. Data were analysed using descriptive analysis techniques. The results indicate that the Preventive Maintenance strategy is the most appropriate strategy for maintaining the machinery at CV Mandiasih because it incurs lower maintenance costs than the Corrective Maintenance strategy, amounting to Rp30,049,776 compared to Rp31,118,971. This study contributes to the management of CV Mandiasih by providing a cost-based analysis for determining the machine maintenance strategy with the minimum maintenance cost in order to enhance the company's profitability.

Keywords: Maintenance strategy, maintenance costs, cost efficiency

INTRODUCTION

Industry is an economic activity that produces goods and services through the application of management functions, including operations management, which plays a role in designing, managing, and controlling production processes to ensure their effective implementation (Veriyanto & Yasin, 2023; Heizer & Render, 2017; Sudaryono et al., 2020). In the manufacturing industry, machinery serves as a primary production factor that supports improvements in production capacity and product quality. However, continuous machine operation may lead to wear, failure, and downtime, thereby reducing productivity and increasing operating costs (Khatab et al., 2018; Stenström et al., 2016). Therefore, implementing an appropriate maintenance strategy, whether preventive or corrective, is essential for maintaining machine reliability, reducing maintenance costs, improving operational efficiency, and maximising company profitability, although the effectiveness

of each strategy should be adapted to the specific conditions of the company (Ansari et al., 2016; Wireman, 2014; Saputra et al., 2020; Fauziyyah & Sriyanto, 2015). One company that faces the importance of effective machine maintenance management is CV Mandiasih, which operates in the production and trading of corn-based animal feed. Consequently, maintaining the operational reliability of its machinery is a crucial aspect of ensuring uninterrupted production processes and consistent product quality.

Figure 1. Corn Milling Machine

Source: Personal Documentation,, 2024

CV Mandiasih uses a corn milling machine as the primary machine in its production process to process raw corn into various processed products, including concentrate, corn flour, polar, wot, and ragil. Consequently, the machine plays a critical role in ensuring the continuity of the production process. The milling process may be performed once or twice, depending on the desired level of product fineness. Production activities are carried out daily, except on Nyepi Day or when the machine experiences a breakdown. The monthly production output for 2024 is presented in Figure 2.

Figure 2. Corn Production Output in 2024

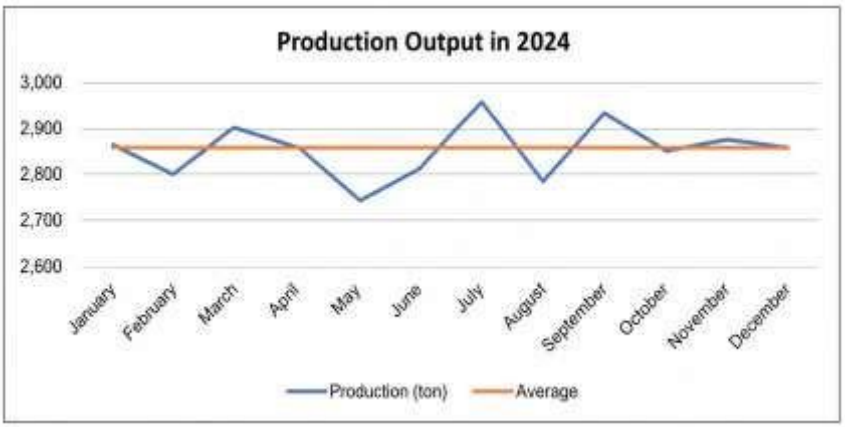

Figure 2 shows the corn production output during 2024. The highest production was recorded in July, with a total output of 2,927 tons of corn products, while the lowest production occurred in May, with a total output of 2,483 tons of corn products. Overall, CV Mandiasih produced 32,504 tons of corn products during 2024, with an average monthly production of 2,709 tons.

The maintenance of the corn milling machine currently employs both preventive maintenance and corrective maintenance methods. Costs incurred for preventive maintenance include routine inspection costs and the replacement of components identified as requiring replacement following inspections. Corrective maintenance costs include expenses associated with replacing machine components that fail before the end

of their expected service life. Details of the maintenance costs incurred and the maintenance activities performed are presented in Table 1.

Table 1. Corn Milling Machine Maintenance Costs in 2024

Month	Preventive maintenance costs (Rp)	Corrective maintenance costs (Rp)
January	2,900,000	5,224,000
February	2,137,000	2,468,000
March	5,730,000	12,307,000
April	2,328,000	1,790,000
May	2,000,000	1,067,500
June	2,000,000	3,537,000
July	4,490,000	23,132,000
August	3,207,000	6,130,000
September	2,500,000	1,375,000
October	2,350,000	3,052,000
November	2,700,000	3,110,000
December	2,000,000	Rp885,000
TOTAL	**38.392.000**	**64.577.500**

Source: Processed by the researcher

Table 1 presents the maintenance costs incurred by CV Mandiasih throughout 2024. Preventive maintenance activities on the corn milling machine generated preventive maintenance costs amounting to Rp38,392,000. Most of these costs were attributable to weekly machine inspections, amounting to Rp500,000 per inspection. Meanwhile, corrective maintenance resulted in total costs of Rp64,577,500, with the expenditures primarily allocated to the purchase of spare parts.

Corrective maintenance was carried out in response to machine failures. These failures resulted in unplanned downtime. Downtime refers to the period during which a machine cannot be operated, thereby disrupting the company's operational activities (Rahmadsyah & Safirin, 2024). Machine failures and the downtime resulting from these failures are presented in Figures 3 and 4.

Figure 3. Machine Failure Trend in 2024

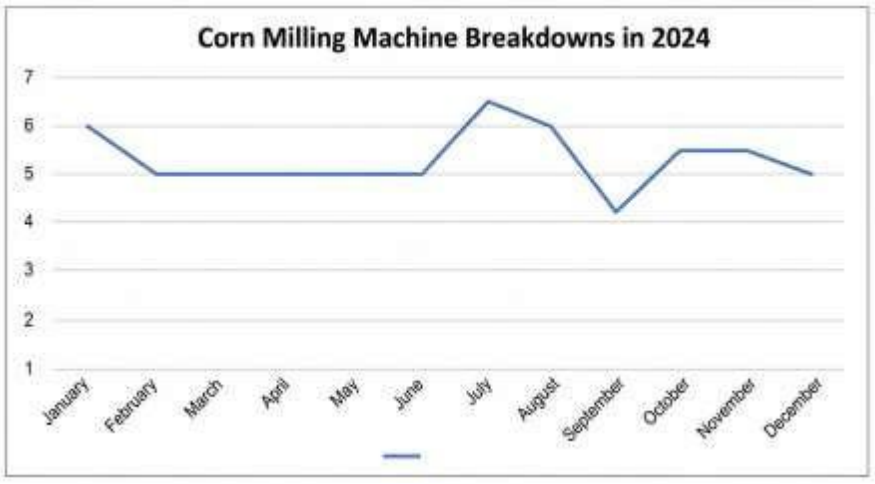

Figure 4. Corn Milling Machine Downtime in 2024

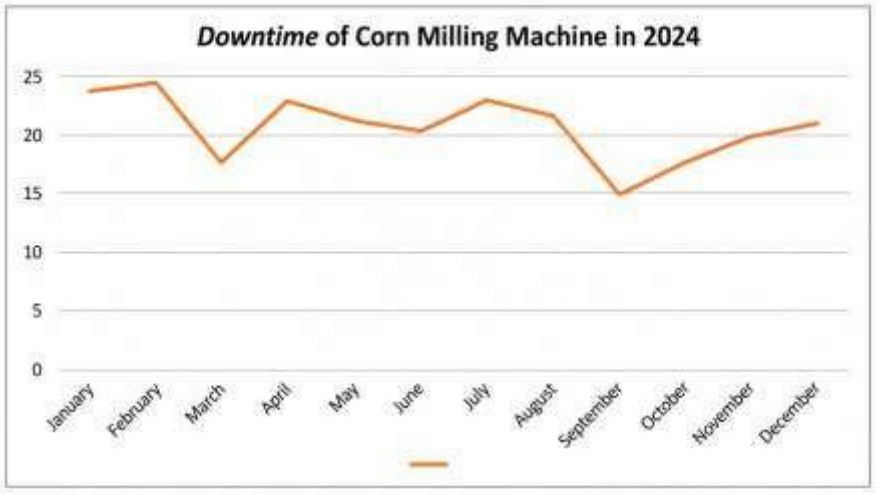

Figure 3 shows that during 2024, the corn milling machine at CV Mandiasih experienced a total of 44 machine failures. The highest number of failures occurred in July, with a total of six failures, while the lowest number occurred in September, with only one failure. These failures resulted in downtime of the corn milling machine. The longest downtime occurred in February, during which the machine experienced 23 hours of downtime. The shortest downtime occurred in September, when the machine was out of operation for seven hours. Overall, the machine experienced a total downtime of 198 hours throughout 2024.

Based on the available data, the company considers its current maintenance costs to be inefficient. The maintenance expenditures incurred by the company do not yet comply with industry standards, which recommend a maintenance cost ratio of 70:30, consisting of 70% preventive maintenance costs and 30% corrective maintenance costs of the total maintenance expenditure (Hamasha et al., 2023). At present, the costs incurred for corrective maintenance exceed those allocated to preventive maintenance. Implementing an appropriate maintenance strategy is expected to help the company reduce maintenance costs. Furthermore, an appropriate maintenance strategy will provide an overview of the cost efficiency achieved compared with the company's existing maintenance practices. Therefore, it is necessary to conduct a study on the maintenance strategy of the corn milling machine at CV Mandiasih.

RESEARCH METHOD

This study employed a descriptive research design with a quantitative approach and a case study method to analyse the maintenance costs of the corn milling machine at CV Mandiasih, located on Jalan Teruna Jaya, Nyitdah, Kediri, Tabanan. The object of the study focused on the maintenance costs of the corn milling machine used in the production process of processed corn rice. The research variables comprised corrective maintenance costs, preventive maintenance costs, and cost efficiency. Corrective maintenance costs refer to the costs incurred for repairs after machine failure, whereas preventive maintenance is performed according to a planned schedule to prevent machine failures. The calculation of both types of maintenance costs was based on repair costs, failure frequency, downtime duration, labour costs, and preventive maintenance costs to

determine the most cost-efficient maintenance policy (Duli, 2019; Rukajat, 2018; Sugiyono, 2016; Azizah et al., 2020; Kadhafi & Hariono, 2023; Yusuf & Budiawan, 2024).

The study population consisted of one corn milling machine used in the production operations of CV Mandiasih. The research utilised both quantitative and qualitative data obtained from primary and secondary sources. Quantitative data included maintenance costs and machine failure records, while qualitative data comprised maintenance standards, the company's history, and the corn rice production process. Primary data were collected through interviews with the owner or the person responsible for the maintenance of facilities and infrastructure. Secondary data consisted of equipment records, machine failure records, maintenance costs, and the maintenance history of the corn milling machine for the period of January–December 2024. Data collection was conducted through interviews and observations of the condition of the machine as well as documents related to the maintenance of the corn milling machine (Arikunto, 2017; Sugiyono, 2017).

The data were analysed descriptively by calculating the monthly failure frequency, corrective maintenance costs, preventive maintenance costs, and maintenance cost efficiency. Cost efficiency was analysed by comparing the planned maintenance costs with the actual maintenance costs, after which the results were classified according to the following efficiency criteria: >100% = inefficient, 100% = moderately efficient, 90%–99% = efficient, and <90% = highly efficient. The results of the analysis were used to compare corrective and preventive maintenance costs, determine the more cost-effective maintenance strategy, and measure the level of maintenance cost efficiency implemented by the company. Furthermore, the findings of this study serve as the basis for providing recommendations to improve the maintenance strategy that can be implemented by CV Mandiasih (Srirahayu & Saleh, 2021; Mahmudi, 2015).

RESULT AND DISCUSSION

Monthly Breakdown Frequency

Table 2. Breakdown Frequency from January to December 2024

Month	Breakdowns	Frequency
January	5	0.114
February	4	0.091
March	3	0.068
April	3	0.068
May	3	0.068
June	3	0.068
July	6	0.136
August	5	0.114
September	1	0.023
October	4	0.091
November	4	0.091
December	3	0.068
TOTAL	**44**	**1**

Source: Processed by the researcher

Table 2 shows that the highest breakdown frequency during the one-year period occurred in July, with a breakdown frequency of 0.136, while the lowest occurred in

September, with a frequency of 0.023. During the year, the corn milling machine at CV Mandiasih experienced a total of 44 breakdowns.

Machine Downtime Cost

Table 3. Operational History of the Corn Milling Machine in 2024

Month	Breakdowns	Downtime Duration (hours)	Expected Machine Operating Time (hours)
January	5	22	279
February	4	23	261
March	3	12	270
April	3	19	270
May	3	17	279
June	3	16	270
July	6	20	279
August	5	18	270
September	1	7	279
October	4	13	270
November	4	15	279
December	3	16	270
TOTAL	**44**	**198**	**3276**

ource: Processed data, 2025

Table 3 shows that throughout 2024, the machine experienced a total of 44 breakdowns. The highest number of breakdowns occurred in July, with six breakdowns, while the lowest occurred in September, with only one breakdown. On average, the machine experienced four breakdowns per month.

Breakdowns of the corn milling machine resulted in downtime, defined as the period during which the machine could not be operated during scheduled operating hours. The total downtime caused by machine breakdowns throughout 2024 amounted to 198 hours. The longest downtime occurred in February, when the machine was inoperable for 23 hours out of 279 scheduled operating hours. Meanwhile, the shortest downtime occurred in March, during which the machine was inoperable for 12 hours out of 270 scheduled operating hours. On average, the machine experienced 16.5 hours of downtime per month. As a result of this downtime, the effective operating time of the machine was reduced to 3,078 hours, or approximately 93.96% of the expected operating time.

Corrective Maintenance Policy Cost

Table 4. Calculation Results of the Corrective Maintenance Policy Cost

Runtime (Tb)	Breakdowns (B)	Repair cost (Cr)	Maint. cost (TCr)	Downtime (TCd)	**Rep. maint. cost (TMC)**
6,318	0,158	64.577.500	10.203.245	20.915.712	**31.118.957**

Source: Processed by the researcher

Based on Table 4, the total cost of implementing the Corrective Maintenance Policy is Rp31,118,957 per month. This amount includes downtime costs of Rp20,915,712.

Preventive Maintenance Policy Cost

T Table 5. Calculation Results of the Preventive Maintenance Policy Cost

Month	Bn	B	TCR(n)	TCm(n)	TCd	TMC(n)
1	0,114	0,114	7.412.216	38.392.000	20.915.712	66.719.942
2	0,091	0,109	7.092.143	19.196.000	20.915.712	47.203.869
3	0,068	0,097	6.359.600	12.797.333	20.915.712	40.072.659
4	0,068	0,090	5.884.369	9.598.000	20.915.712	36.398.095
5	0,068	0,087	5.657.761	7.678.400	20.915.712	34.251.887
6	0,068	0,084	5.510.015	6.398.667	20.915.712	32.824.407
7	0,136	0,093	6.040.009	5.484.571	20.915.712	32.440.306
8	0,114	0,102	6.650.456	4.799.000	20.915.712	32.365.182
9	0,023	0,094	6.107.388	4.265.778	20.915.712	31.288.892
10	0,091	0,086	5.609.964	3.839.200	20.915.712	30.364.890
11	0,091	0,092	5.989.103	3.490.182	20.915.712	30.395.011
12	0,068	0,091	5.934.717	3.199.333	20.915.712	30.049.776

Source: Processed by the researcher

Based on the calculation of the Preventive Maintenance Policy costs, the minimum preventive maintenance cost was obtained when maintenance was performed at a 12-month interval, amounting to Rp30,049,776. Therefore, it can be concluded that the cost of implementing the Preventive Maintenance Policy is Rp30,049,776.

Discussion

Comparison of the Costs of the Corrective Maintenance Policy and the Preventive Maintenance Policy

Table 6. Comparison of the Costs of the Corrective Maintenance Policy and the Preventive Maintenance Policy

Corrective Maintenance Policy (Rp)	Preventive Maintenance Policy (Rp)
31.118.971	30.049.776

Source: Processed by the researcher

Table 6 shows that the maintenance cost of the corn milling machine under the Preventive Maintenance Policy is lower than that under the Corrective Maintenance Policy. Therefore, from a cost perspective, the optimal maintenance policy for the corn milling machine is the implementation of the Preventive Maintenance Policy.

Cost Efficiency

Table 7. Cost Efficiency

Strategy	Cost/Year (Rp)
Maintenance cost before policy implementation	102,969,500
Maintenance cost after policy implementation	30.049.776
Efficiency level	29%

Source: Processed by the researcher

Based on Table 7, it can be seen that by implementing the recommended Preventive Maintenance strategy, the company is projected to incur maintenance costs equivalent to only 29% of its actual maintenance expenditure. According to the efficiency

criteria presented in Table 7, this strategy is classified as highly efficient in terms of maintenance costs.

CONCLUSION

This study aimed to determine the most appropriate maintenance strategy based on maintenance costs. Based on the results of the data analysis, the following conclusions were drawn:

1) The current maintenance practice for the corn milling machine at CV Mandiasih consists of both preventive and corrective maintenance methods. Preventive maintenance is carried out through periodic machine inspections conducted by machine specialists and CV Mandiasih employees to assess the machine's condition, followed by scheduled replacement of machine components. Meanwhile, corrective maintenance involves replacing damaged machine components to restore the machine to operational condition.
2) The results of the data analysis indicate that the maintenance method with the lowest cost is the Preventive Maintenance Policy. The maintenance cost incurred under the Preventive Maintenance Policy amounts to Rp30,049,776, whereas the Corrective Maintenance Policy incurs a maintenance cost of Rp31,118,971.
3) The maintenance strategy that should be adopted by CV Mandiasih to minimise maintenance costs is the Preventive Maintenance Policy. The results of the analysis demonstrate that by implementing preventive maintenance for its corn milling machine, CV Mandiasih can reduce maintenance costs compared with implementing the Corrective Maintenance Policy.
4) The results of the data analysis further indicate that if CV Mandiasih implements the Preventive Maintenance Policy, the resulting maintenance cost will amount to only 29% of its current maintenance expenditure. This finding demonstrates that the Preventive Maintenance Policy is highly cost-efficient compared with the company's existing maintenance costs.

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