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Analysis of Washing Machine Maintenance Strategy Using Preventive Maintenance Approach in Laundry Unit of XYZ Hospital

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ABSTRACT
Hospital laundry units play a crucial role in supporting healthcare services, particularly in maintaining the availability of clean and hygienic linen. Conditions at the Laundry Unit of XYZ Hospital revealed problems such as relatively frequent washing machine breakdowns, high operational downtime, and reactive maintenance activities. These conditions hamper the smooth running of the linen washing process and increase maintenance costs. This study aims to analyze washing machine maintenance strategies using a preventive maintenance approach to improve machine reliability and reduce the risk of breakdowns. The research method used was a case study with a descriptive-analytical approach. Data were collected through direct observation, interviews with operators, and historical machine breakdown data. Analysis was conducted using maintenance performance indicators such as breakdown frequency, machine downtime, and critical components that frequently experience problems. The results showed that the dominant damage was caused by a lack of routine maintenance and the absence of a structured preventive maintenance schedule. The outputs of this study were a proposed preventive maintenance schedule, a periodic maintenance checklist, and recommendations for maintenance strategies that could reduce machine downtime and improve the operational reliability of the laundry unit at XYZ Hospital. Maintenance performance analysis was conducted using MTBF, MTTR, and availability indicators as the basis for preparing preventive maintenance proposals.

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1. Introduction

Hospital laundries play a strategic role in supporting healthcare services, particularly in ensuring linen cleanliness and preventing the spread of infection. Hospital laundry processes differ from commercial laundries due to high volumes, long operating hours, and strict hygiene standards. These conditions require intensive workloads on washing machines,

necessitating appropriate maintenance strategies to maintain reliable performance. In practice, many hospital laundries still rely on reactive maintenance, where repairs are performed after damage occurs.

This strategy tends to cause unplanned downtime and potentially disrupts hospital service flow. Based on these conditions, an evaluation of the implemented washing machine maintenance strategy is necessary to determine whether the existing maintenance system is effective or requires improvement. This study aims to analyze the washing machine maintenance strategy in the laundry unit at XYZ Hospital and propose more planned and sustainable improvements.

Based on preliminary data obtained from the Laundry Unit at XYZ Hospital, the washing machines operate an average of 8–12 hours per day with high usage intensity. During the observation period, machine breakdowns occurred an average of 3–5 times per month with downtime of 8–12 hours per month. A low MTBF value indicates a high frequency of machine breakdowns, and impacts the continuity of the hospital's laundry service. Therefore, a more planned and preventative maintenance strategy is needed to reduce the risk of damage and improve the operational performance of the washing machines.

Table 1. Operational Data of Washing Machines in the Laundry Unit at XYZ Hospital

No	Washing machine	Capacity (KG)	Operating Hours/Day	Machine Age (Years)
1	Mesin A	25	10	6
2	Machine B	30	12	7
3	Machine C	20	8	5

(Source: XYZ Hospital, 2025)

Based on Table 1, the washing machines in the Laundry Unit of XYZ Hospital have relatively high operating hours, between 8–12 hours per day, with a machine lifespan of 5–7 years. These high operating hours indicate that the machines are operating intensively to support the hospital's service needs. This condition increases the risk of component wear if not balanced with a planned maintenance system. According to Anashrullah & Nilam Sari (2024), the high intensity of laundry machine use requires the implementation of preventive maintenance to maintain operational reliability and efficiency.

2. Literature Study

Conceptual Framework of the Research

Based on a literature review, preventive maintenance is a scheduled maintenance strategy designed to prevent sudden machine failures. This approach aims to improve machine reliability, reduce downtime, and extend equipment lifespan.

In this study, the concept of preventive maintenance was applied through identifying the operational conditions of washing machines, analyzing the frequency of breakdowns, and determining critical components requiring regular maintenance. Indicators used in the analysis included breakdown frequency, machine downtime, and the dominant type of

breakdown. The results of this analysis were used as the basis for developing a proposed maintenance strategy, including a maintenance schedule and a preventive maintenance checklist.

This literature review was designed to provide a theoretical and empirical basis for machine maintenance strategies, specifically for industrial laundry equipment and hospital facilities. The primary focus of the literature covers machine maintenance concepts, maintenance strategy classifications, and previous research findings relevant to this research topic.

Machine maintenance is defined as a series of technical activities aimed at maintaining equipment in operating condition according to established functions and standards. Maintenance strategies are generally classified into reactive, preventive, and reliability-based maintenance. Reactive maintenance is performed after a machine malfunction occurs, while preventive maintenance is performed on a scheduled basis to prevent damage and reduce the risk of downtime (Setiawan & Permana, 2025).

Research by Suprapto (2025) shows that implementing planned preventive maintenance can increase the lifespan of industrial machines and reduce the frequency of critical component failures. These results confirm that periodic and documented maintenance has a positive impact on machine reliability.

Research by Anashrullah and Nilam Sari (2024) examined laundry machine maintenance management strategies with the aim of improving equipment efficiency and reliability. The results showed that the implementation of reactive maintenance led to a high frequency of operational disruptions and a reliance on emergency repairs. The study recommended the implementation of planned preventive maintenance through periodic maintenance scheduling and the use of reliability indicators such as MTBF and MTTR. These findings are relevant to the study on the laundry unit at XYZ Hospital, as they demonstrate that a shift from reactive maintenance to planned preventive maintenance is necessary to maintain the reliability of washing machines with high operating intensity.

In the context of healthcare facilities, machine maintenance strategies play a crucial role because equipment failure not only impacts repair costs but also disrupts service quality. Sari and Ridho (2024) state that the Reliability Centered Maintenance (RCM) approach is effective for identifying critical components and determining optimal maintenance intervals based on machine failure characteristics.

Another study by Siagian et al. (2024) confirmed that a combination of preventive maintenance and reliability analysis can significantly reduce machine downtime in industrial environments with high operating intensity. These findings are relevant to the continuous operation of hospital laundry machines.

Based on the literature review, it was concluded that a planned, reliability-based preventive maintenance strategy is an appropriate approach for hospital laundry washing machines. The reviewed literature serves as the basis for analyzing the maintenance conditions of washing machines at XYZ Hospital and formulating a more systematic and measurable maintenance strategy.

Research Gap This research, although various studies have discussed the application of preventive maintenance and Reliability Centered Maintenance (RCM) in industrial machines and public facilities, studies that specifically address hospital laundry washing machines, especially the washer extractor or barrier washer types with separate infectious and non-infectious paths, are still limited. Most previous studies have focused on manufacturing environments or commercial laundries with different operating characteristics.

Furthermore, research linking actual machine conditions, daily maintenance practices, and operator complaints as a basis for evaluating maintenance strategies is still rare. Therefore, this study fills this gap by analyzing washing machine maintenance strategies in the laundry unit at XYZ Hospital based on actual operational data, thus providing a practical and applicable contribution to the management of hospital laundry machine maintenance.

Calculation of Maintenance Performance Indicators

To evaluate the performance of the washing machine maintenance system in the laundry unit of XYZ Hospital, reliability indicators commonly applied in machine maintenance management are used, namely Mean Time Between Failure (MTBF), Mean Time To Repair (MTTR), and Availability. These three indicators are used to describe the level of reliability, ease of repair, and availability of the machine during the operational period. These indicators are used in processing washing machine maintenance data at XYZ Hospital.

a. Mean Time Between Failure (MTBF)

MTBF indicates the average operating time of a machine before the next failure occurs. The MTBF value is calculated using the equation:

$$MTBF = \frac{Total\ waktu\ operasi\ mesin}{Jumlah\ kerusakan} \qquad (1)$$

Total operating time is obtained from the accumulated machine hours during the observation period, while the number of failures is calculated based on the frequency of recorded failures. A low MTBF value indicates that the machine experiences failures within a relatively short time interval, resulting in a low level of reliability.

b. Mean Time To Repair (MTTR)

MTTR describes the average time required to repair a machine and return it to normal operation. MTTR is calculated using the equation:

$$MTTR = \frac{Total\ waktu\ perbaikan}{Jumlah\ kejadian\ kerusakan} \qquad (2)$$

Total repair time is obtained from the duration of downtime due to machine maintenance and repair activities.

A high MTTR value indicates that the repair process requires a relatively long time, which is caused by limited resources, complex damage diagnosis, or the absence of structured maintenance planning.

c. Availability

Availability indicates the degree to which a machine is available to operate effectively, calculated based on the relationship between MTBF and MTTR. Availability is formulated as follows:

$$Availability = \frac{MTBF}{MTBF+MTTR} \qquad (3)$$

A low availability value reflects a high proportion of machine downtime. In the context of a hospital laundry unit, low availability disrupts service continuity and increases the workload on other machines.

d. Interpretation of Indicators

The MTBF, MTTR, and availability calculations are used to evaluate the effectiveness of the implemented maintenance strategy. A low MTBF and high MTTR indicate a predominance of reactive maintenance, while an increase in MTBF and a decrease in MTTR indicate the effectiveness of planned preventive maintenance.

3. Research Methodology

This study uses a case study method with a descriptive and analytical approach to determine the maintenance conditions of washing machines used in the laundry unit of XYZ Hospital. The descriptive approach aims to describe the condition of the machine and the maintenance activities carried out, while the analytical approach is used to assess the maintenance strategies that have been implemented. This study applies a case study method with a descriptive and analytical approach to examine the maintenance conditions of washing machines in the laundry unit of XYZ Hospital. The descriptive approach is used to describe the actual condition of the machine and the ongoing maintenance activities, while the analytical approach aims to assess the effectiveness of the maintenance strategies implemented based on the machine's performance parameters.

The research object in this study is the washing machine in the laundry unit at XYZ Hospital, which was chosen because it plays a crucial role in supporting hospital operations and is used continuously. The high frequency of washing machine use necessitates proper maintenance management to ensure optimal operation and minimize frequent breakdowns.

The data used consisted of primary and secondary data. Primary data was obtained through direct observation of washing machine conditions and maintenance activities, including physical condition, frequency of breakdowns, and downtime. Furthermore, primary data was collected through brief interviews with laundry operators and technicians to obtain information regarding maintenance procedures and common problems encountered in the field.

Secondary data was obtained from supporting documents, such as machine technical specifications, maintenance and repair records, and existing maintenance schedules. This data was also supplemented by literature studies in the form of journals discussing machine maintenance strategies, preventive maintenance, and machine performance indicators such as Mean Time Between Failure (MTBF), Mean Time To Repair (MTTR), and downtime.

The research phase began with identifying the current condition of the machines, followed by an analysis of the maintenance strategies implemented in the laundry unit. The analysis was conducted by comparing field conditions with machine maintenance concepts found in the literature. The final phase of the research was the development of proposed maintenance strategy improvements, which would increase washing machine reliability and reduce downtime.

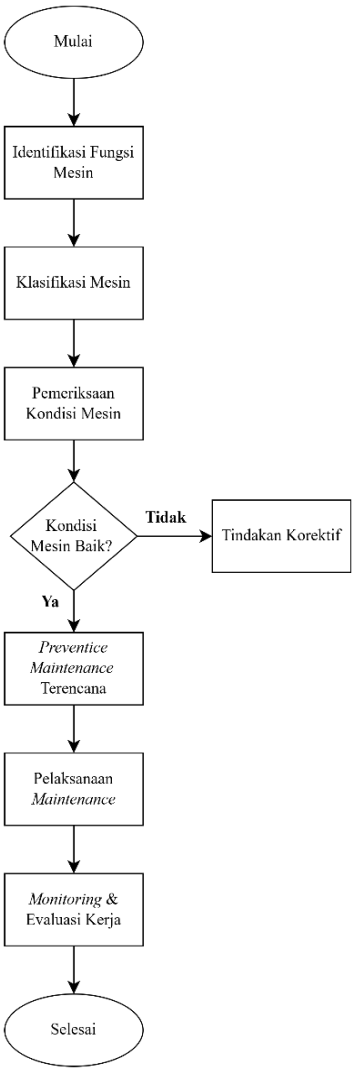

Figure 1. Flowchart of Research Methodology at XYZ Hospital

4. Research Results and Discussion

The analysis results show that washing machine damage most often occurs in components such as the motor, belt, or drainage system. The high frequency of damage is related to the machine's operating hours, which reach 8–12 hours per day, and the absence of a documented preventive maintenance schedule. This condition is in line with the preventive maintenance theory, which states that machines with high operating hours require regular inspection and maintenance to maintain their reliability. When compared to the preventive maintenance concept applied to the laundry unit according to Anashrullah and Nilam Sari (2024), the

condition of washing machine maintenance in the Laundry Unit of XYZ Hospital still tends to be reactive, where repairs are carried out after damage occurs. This reactive approach has an impact on increasing machine downtime and decreasing operational reliability. This is in line with the findings

Suprapto (2025) stated that the absence of scheduled preventive maintenance accelerates the decline in machine performance and service life.

In addition, research by Setiawan and Permana (2025) shows that consistent implementation of preventive maintenance has a significant effect on increasing the service life and performance stability of production machines. Conditions at XYZ Hospital also show that the identification of machine functions and failures is not optimal as emphasized in the Reliability Centered Maintenance (RCM) approach by Sari and Ridho (2024) and Siagian et al. (2024), which emphasizes the importance of failure analysis as a basis for determining maintenance strategies. Therefore, the implementation of structured preventive maintenance based on machine operational conditions is a relevant solution to reduce the risk of damage, reduce downtime, and improve the operational performance of washing machines in the Laundry Unit of XYZ Hospital.

Table 2. Washing Machine Data for Laundry Unit at XYZ Hospital

No	Machine Type	Capacity	Amount	Information
1	*Washer Extractor / Barrier Washer*	70–100 kg	3 Unit	Non-infectious
2	*Washer Extractor / Barrier Washer*	70–100 kg	1 Unit	Infectious only

(Source: XYZ Hospital, 2025)

The machine used is a heavy-duty machine with an average operating time of 10 hours per day, 7 days a week. The machine's lifespan ranges from 5–10 years, depending on the intensity of use and the quality of maintenance. While the machine is still operational, it often experiences problems if maintenance is not optimal. Common problems include unstable engine RPM, leaks due to overloading or laundry residue, and increased vibration and noise.

Table 3. 1 Washing Machine Maintenance Checklist

Maintenance Activities	Frequency
Cleaning the drum after the cycle	Daily
Door seal /rubber inspection	Daily
Check for leaks	Daily
Water temperature check and disinfection program	Daily
Observation of engine vibrations and sounds	Daily
Cleaning the external filter	Weekly
Flush the drum with hot water	Weekly
Lubrication of gears, fan belts, and motors	Periodic

(Source: XYZ Hospital, 2025)

Operator Complaints report several subjective complaints, such as high engine noise levels and excessive heat from the boiler system. These complaints indicate component wear or suboptimal operating settings.

Analysis of maintenance strategies based on observations revealed that the implemented maintenance strategy still tends to be reactive. Maintenance is performed when the machine already shows signs of damage. This situation has resulted in increased machine downtime recorded during the observation period. Therefore, a shift to a planned, preventative maintenance strategy with a routine inspection schedule and systematic recording of machine conditions is necessary.

Observed maintenance in the laundry unit indicates a tendency to use a reactive maintenance strategy, where maintenance actions are carried out after a decline in performance or machine failure occurs. From a reliability engineering perspective, this approach is associated with a relatively low Mean Time Between Failure (MTBF) value, because potential failures are not controlled from an early stage. In addition, unplanned repair activities generally require longer repair times due to the damage diagnosis process and limited resource readiness, thus impacting on increasing the Mean Time To Repair (MTTR). The combination of low MTBF and high MTTR further impacts the level of machine availability, which limits the effective operating time of the equipment.

To improve maintenance performance, a shift toward a planned preventive maintenance strategy that emphasizes periodic inspections, scheduled maintenance, and component replacement based on time intervals or operating hours is necessary. Conceptually, this strategy can increase MTBF by preventing unexpected failures and reduce MTTR through more structured and well-prepared maintenance activities. The effectiveness of preventive maintenance implementation depends heavily on the availability of a systematic system for recording operational and failure data, which allows for continuous evaluation of MTBF, MTTR, and availability as a basis for data-driven maintenance decisions.

Table 4. Washing Machine Damage Frequency Data

No	Type of Damage	Frequency (times/month)	Rata-rata Downtime (jam)
1	The engine is not turning	4	2,0
2	Water does not come out	3	1,5
3	Excessive vibration	4	2,5
4	Heat engine	2	3,0
5	Water leak	3	1,0

(Source: XYZ Hospital, 2025)

Table 4.3 shows that the most frequent failure was excessive vibration, occurring five times per month and with an average downtime of 2.5 hours. This failure caused further damage to machine components. The relatively high total downtime indicates that maintenance was still reactive. This aligns with Suprapto's (2025) findings, which state that irregular preventive maintenance increases downtime and reduces the reliability of industrial machines.

Table 5. Washing Machine Maintenance Performance Indicators

Indicator	Current Condition of VYZ Hospital	Impact
Frequency of damage	High (3 times/month)	Operations disrupted
Machine downtime	High (10 hours/month)	Delayed washing
Care pattern	Reactive	Repair costs increase
Maintenance schedule	Unstructured	Engine age decreases

(Source: XYZ Hospital, 2025)

Based on maintenance performance indicators, the washing machine maintenance system at XYZ Hospital demonstrated suboptimal performance. The high frequency of breakdowns and significant downtime indicated low machine reliability, which resulted in reduced equipment availability to support laundry unit operations. This condition was reflected in the instability of machine operating times during the observation period.

The current maintenance pattern is still dominated by a reactive approach, where repairs are performed after a disruption or failure occurs. In the context of maintenance management, this pattern is associated with a short interval between failures (MTBF) and a relatively long time to repair (MTTR), as maintenance activities are unscheduled and performed after a failure occurs. This combination of conditions contributes to increased downtime and decreased machine availability.

In line with these results, Setiawan and Permana (2025) reported that implementing scheduled preventive maintenance increased machine lifespan and reduced the frequency of breakdowns. Therefore, implementing a preventive maintenance strategy supported by systematic recording of operational and breakdown data is used as an improvement approach in managing washing machine maintenance at XYZ Hospital.

Table 6. Comparison of Actual Conditions with the Preventive Maintenance Concept

Aspect	Condition of XYZ Hospital	Preventive Maintenance (Literaratur)
Care pattern	Reactive	Scheduled and systematic
Damage handling	After Damage	Prevention
Downtime	High	Low
Machine service life	Shorter	Longer

(Source: XYZ Hospital, 2025)

This comparison demonstrates a gap between the actual maintenance conditions at XYZ Hospital and the preventive maintenance concept described by Anashrullah & Nilam Sari (2024). The preventive approach emphasizes scheduled maintenance to prevent machine failure, while XYZ Hospital still focuses on repairs after damage has occurred. This explains the relatively high downtime and frequency of breakdowns.

Table 7. Proposed Washing Machine Preventive Maintenance Schedule

Maintenance Activities	Component	Frequency
Filter cleaning	Filter air	Daily

Vibration check	Drum and machine feet	Weekly
Belt inspection	Drive system	Weekly
Lubrication	Bearings and shafts	Monthly
Motor inspection	Drive motor	Monthly

(Source: XYZ Hospital, 2025)

The proposed preventive maintenance focused on components that frequently experience problems and have a significant impact on machine operation. High levels of excessive vibration were caused by drum imbalance and bearing wear, which were not detected early due to the lack of regular preventive inspections. The proposed maintenance schedule was based on components with the highest frequency of problems and the greatest downtime. A similar approach was also applied in the research of Sari & Ridho (2024) and Siagian et al. (2024), which concluded that scheduled maintenance based on machine condition improves reliability and operational efficiency.

5. Conclusion

Based on the analysis and discussion, it was concluded that the washing machine maintenance strategy in the laundry unit at XYZ Hospital is still dominated by a reactive maintenance approach, which involves maintenance performed after the machine experiences a breakdown or performance decline. This condition results in unstable operation of the washing machines, increased frequency of interruptions, and the risk of downtime, which hinders the smooth running of the hospital's laundry process.

The research also showed that the washing machines used are heavy-duty machines with large capacities and long operating times, thus requiring a more planned and systematic maintenance strategy. Implementing planned preventive maintenance, supported by daily maintenance checklists, periodic inspection schedules, and performance monitoring and evaluation activities, is a more appropriate approach to maintaining washing machine reliability.

By implementing a proposed planned preventive maintenance strategy, the laundry unit at XYZ Hospital was able to minimize downtime, maintain stable machine performance, and support the ongoing operation of the hospital's laundry. The results of this study serve as the basis for developing a more effective and measurable hospital laundry machine maintenance system.

References

Anashrullah and M. N. Sari, “Maintenance management strategy at Faringa laundry: Improving efficiency and reliability,” Journal of Multidimensional Management, vol. 1, no. 1, pp. 17–20, 2024.

B. Setiawan and D. Permana, “The effect of preventive maintenance on the service life of textile production machines,” Scientific Journal of Engineering Science and Technology, vol. 8, no. 1, pp. 21–26, 2025.

DP Sari and MF Ridho, "Evaluation of maintenance management using the reliability centered maintenance (RCM) II method on production machines," J@ti Undip: Jurnal Teknik Industri, vol. 11, no. 2, pp. 73–80, 2024.

II Siagian, PJ Ginting, and AC Sembiring, "Analysis of critical machine maintenance using the reliability centered maintenance (RCM) method in a palm oil mill," Jurnal Ilmiah Teknik Industri Prima (JURITI PRIMA), vol. 7, no. 2, 2024.

M. Suprapto, "Preventive maintenance strategies to increase industrial machine life," Journal of Renewable Engineering, vol. 2, no. 2, pp. 1–12, 2025.