Survey of Maintenance Implementation on Laundry Business in Indonesia, Jakarta Region

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Abstract

Maintenance has been defined as a combination of technical aspects and management acts', such as supervision, intended to maintain objects in a state where they can perform the required function, repairs, and other tasks. On the other hand, the laundry service business is one of the SMEs which is currently growing rapidly along with changes in people's lifestyles in Indonesia. Proper maintenance practices will improve laundry business performance through impact on quality, efficiency, and effectiveness of operations. This research was conducted using direct interviews with the laundry business to catch in-depth analysis about the maintenance implementation. The data is then processed using the Cramer t-test resulting in the analysis that shows only 3 factors are strongly associated with the "Good" level of maintenance implementation, there are Maintenance resources, Maintenance cost, and Failure. While the rest of the maintenance variables are not strongly associated with a "Good" level of maintenance implementation. It can be concluded that several maintenance variables contribute significantly to the optimum maintenance implementation and several maintenance variables correlate to each other.

Keywords
Maintenance Variables, Laundry Business, Maintenance Survey, Cramer t-test

1. Introduction

Maintenance has been defined as a combination of technical aspects and management acts' according to the British Standard Glossary of Term (3811:1993), such as supervision, intended to maintain objects in a state where they can perform the required function, repairs, and other tasks. Maintenance has a contribution to reducing equipment downtime, improving product quality, and increasing productivity (Shyjith et al., 2008). An organization's profit, quality, and service can be increased with the proper maintenance practices within the organization. Maintenance management is complex as the output of maintenance is not easy to measure and the costs of maintenance are usually high (Ilangkumaran and Kumanan 2009). The contribution of maintenance cost to total production cost is between 15-70 percent depending on the type of industry (Shyjith et al., 2008; Ilangkumaran and Kumanan 2009; Naughton et al., 2013). In the production and operational processes of the company, machine and equipment maintenance factors play an important role that determining the ups and downs of not only production levels but also employee morale and job satisfaction. If deadlines or production quotas are pursued, machine and equipment maintenance is often ignored or skipped because it is not considered important. Whereas machines and equipment that are not well maintained will produce less than perfect products and may have to be discarded because they are not used. Maintenance times should be scheduled as part of the business' production process. Immature of maintenance planning process is reflected in some activities as significant fluctuation of the number of work order, delay time between two maintenance jobs which generates idle time of field technicians, unbalanced work distribution between the technician, and difficulties to meet work completion target (Nurcahyo et al., 2018). Discipline in maintenance will be able to produce good products and can save even greater repair costs if machines and equipment are damaged due to not being maintained regularly.

SMEs have a strategic role in the Indonesian economy including their position as a major player in various economic sectors, the largest provider of employment, the creator of new markets and sources of information, playing an important role in the development of local economic activities and community empowerment, and their contribution

to the balance of payments (Bank Indonesia, 2015). A laundry service business is one of the SMEs which is currently growing rapidly along with changes in people's lifestyles in Indonesia, especially residents in urban areas often prefer a more practical way, namely relying on laundry services to replace clothes washing activities and this is where the market is very potential. to be targeted in the laundry industry. For reasons of practicality and costs that are considered quite cheap, the existence of laundry services is increasingly being found with each advantage to attract customers. The results of the laundry that are clean, neat, and on time are the quality of the product to be a determining factor to compete. Proper maintenance practices will improve business performance through impact on quality, efficiency, and effectiveness of operations. Furthermore, it can increase competitiveness in the market through productivity and value advantages (Alsyouf 2009).

Therefore, this paper aims to identify the factors that are the main ingredients of successful and appropriate care practices in SMEs Laundry. The empirical approach is used through a survey involving laundry SMEs, both independent and in the form of a franchise.

1.1 Objectives

Seeing the prospects and the laundry business market which are increasingly advanced along with the development of technology and equipment innovation. So to increase competitiveness through product quality, Laundry business actors must maintain their facilities and equipment to serve customers well. The purpose of this study is to assess the implementation of maintenance in SME Laundry in Indonesia.

2. Literature Review

2.1 Maintenance

Maintenance has developed over time as technology has advanced and new research has been conducted to create more effective and convenient systems (Ayo-Imoru & Cilliers, 2018). Maintenance quality has a direct impact on the output of the production system (quality, quantity, and safety) and determines the enterprise's profitability level (Nurcahyo et al., 2018). Maintenance measurement, according to Cholasuke et al. (2004), is required to obtain quantitative information on maintenance goals and maintenance actions to be taken to improve operation function performance. After conducting a literature review, six main maintenance characteristics were chosen in this study. Those six characteristics are scheduled/periodic maintenance, maintenance time, maintenance resource, failure, maintenance activities, and life cycle cost (Table 1). In addition, Table 2 describes the detailed references from papers and textbooks.

Table 1. Maintenance Measurement based on Literature Study

Maintenance Characteristics	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14
Scheduled/periodic maintenance	✓	✓	✓	-	-	✓	✓	✓	-	✓	✓	-	✓	✓
Maintenance time	-	-	-	✓	✓	✓	-	-	-	-	-	✓	-	✓
Maintenance resource	-	-	-	-	-	-	-	-	-	-	✓	✓	✓	✓
Failure	-	-	-	-	-	✓	-	-	-	✓	✓	✓	✓	✓
Maintenance activities	-	-	-	-	-	✓	-	-	-	✓	-	✓	✓	✓
Life cycle cost	-	-	-	-	-	-	-	-	✓	✓	✓	✓	-	-

Table 2. Detailed References for Literature Study of Maintenance Measurement

Reference Code	Year	Author	Title
R1	2021	Jingjing Wang et al.	Optimal condition-based preventive maintenance policy for balanced systems
R2	2018	Li Yang et al.	A two-phase preventive maintenance policy considering imperfect repair and postponed replacement
R3	2017	Suzan Alaswad, Yisha Xiang	A review on condition-based maintenance optimization models for stochastically deteriorating system
R4	2019	Dezhen Yang et al.	Condition-Based Preventive Maintenance Optimization Approach for Multiple Industrial Robotics with Stochastic Mission
R5	2013	Liu Fan-mao et al.	Maintenance decision-making method for manufacturing system based on cost and arithmetic reduction of intensity mode
R6	2007	Zimin Yang et al.	Maintenance Priority Assignment Utilizing On-line Production Information
R7	2017	Ernnie Illyani Basri et al.	Preventive maintenance (PM) planning: a review
R8	2012	Mohamed Almomani et al.	Preventive maintenance planning using group technology
R9	2011	Anil Sharma & G.S Yadava	A literature review and future persepectives on maintenance optimization
R10	2006	José A Caldeira Duarte et al.	Optimization of the preventive maintenance plan of a series components system
R11	2008	Khaled Moh. El-Said et al.	Comparison of Reliability Characteristics of Two Systems with Preventive Maintenance and Different Modes
R12	2020	Joshua Qiang Li et al.	Aggregate Characteristics-Based Preventive Maintenance Treatments for Optimized Skid Resistance of Pavements
R13	2014	Umar M. Al-Turki et al.	Integrated Maintenance Planning in Manufacturing
R14	2009	Mohamed Ben-Daya et al.	Handbook of Maintenance Management and Engineering

Based on the six maintenance measurement described in Table 1, here is the definition of each characteristic:

a. Scheduled/periodic maintenance is carried at predetermined intervals based on the number of flight hours, the number of cycles (such as turn-on/off, takeoffs, and landings), and so on. It consists mainly of inspections, maintenance, corrosion prevention, and so on..
b. Maintenance time is the amount of time it takes to perform maintenance on an item, including technical, logistical, and internal administrative delays.
c. Spare parts, skilled labor (craftsmen), tools, instruments, time, and money are all examples of maintenance resources. Capacity planning decisions for each planning period include the number of employees, backlog level, overtime workload, and subcontract workload. The item uses external resources besides just maintenance to perform the required function. The absence of external resources, other than maintenance, has no effect on the item's availability. For instance, power, manpower, fuel, compressed air, a cooling source, lifting services, and scaffolding.
d. Failure is the loss of an item's ability to operate properly.
e. Maintenance activities include tasks such as inspection, condition monitoring, compliance testing, function check-out, routine maintenance, overhaul, and so on.
f. The life cycle cost of an item is defined as the sum of its costs over its entire life cycle. The total life cycle cost of an item may only include the costs of acquisition, operation, maintenance, and disposal for the user or owner. The repair and maintenance cost component is included in the maintenance cost component (Nurcahyo et al., 2020)

2.2 Laundry Business

Several studies on the laundry business have been carried out by several researchers. In 2010, Wan & Seng explored the competitive dynamics of franchising relationships in the laundry business from franchisees' perspective. They adopt an innovative lens, the awareness-motivation-capability (AMC) approach to advancing in-depth knowledge of franchisor-franchisor (F-F) relationships in service-process-based business chains with 25 franchisees. They discover that the overall performance of the laundry franchising service business is well connected with the cooperative quality of F-F relationships, which in turn are highly influenced by the awareness, motivation, and capability of franchisees. Fadilla et al. (2017) discuss a joint optimization problem of the hospital supply chain that shows great opportunity for reducing cost and improving service level for laundry. They proposed an optimal laundry plan that minimizes the total cost of washing and storage. Secondly, by considering the effect of the laundry plan on the failure rate of the Laundromat as well as on the average number of failures, they proposed an imperfect maintenance policy that reduces the failure rate during every maintenance period to obtain the optimal number of preventive maintenance actions. Budi et al. (2020) analyzed the competence of laundry business employees in the implementation of ISO 14001:2015. The result shows that the employees in the laundry industry have adequate and above-average competence in implementing 14001, they are aware of environmental policies and regulations, as well as waste types and disposal methods.

3. Methods

Several steps are carried out to achieve the research objectives of this study. First, a literature review was conducted to get a better understanding of the topic and to determine the research objective. After getting a clear picture of the topic of this research, a survey questionnaire was created based on the research objective and the purpose of this study. Questions are divided into two types which are general questions and specific questions. The general question contains questions regarding the operation of the laundry business. Meanwhile, specific questions refer to the six maintenance measurements which are scheduled/periodic maintenance, maintenance time, maintenance resource, failure, maintenance activities, and life cycle cost. Data collection was conducted by interviewing 35 respondents who operate the laundry business. After gathering the data, a statistical test (t-test) and correlation were carried out to analyze and get a conclusion. Figure 1. shows the steps that are carried out in this study.

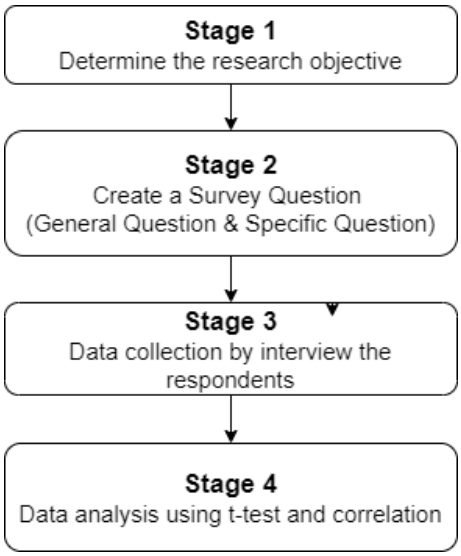

Figure 1. Research Methodology

4. Data Collection

Following its objectives, the study was conducted to determine the level of maintenance implementation in the laundry business. The data needed to describe and determine the level of maintenance implementation was collected using the interview method. Interviews were conducted directly with the owners and workers of the laundry business to get real data. In total, there are 35 laundry businesses around Jakarta (25 outlets) and Malang (10 outlets) areas that are the object of the interview. The interview was conducted for 1 week in the 1st week of October 2021. Meanwhile, the Google form application was used to help collect data at the time of the interview.

Interviews were conducted by asking questions related to the implementation of maintenance. There are 2 categories of questions asked during the interview:

a) The first category is in the form of general questions about the laundry business. There are 6 questions to describe the laundry business in general, starting from ownership status, the number of employees, operational time, the time of the laundry business was established and equipment that frequently breakdown. The questions in the first category are in the form of open-ended questions and questions with answer choices. The first category questions were compiled based on the results of discussions by the authors.
b) The second category is in the form of specific questions about maintenance implementation. It is a Likert scale question on maintenance variables to determine the level of maintenance implementation in the laundry business. The Likert questions were made by referring to a paper on hospital maintenance (Laksono et al., 2021) and a paper on maintenance in the wood and furniture industry (Nisa et al., 2021). There are 6 questions about maintenance variables with 3 option answers that represent the level of maintenance implementation. The maintenance variables on the questions consist of Maintenance schedule, Maintenance time, Maintenance resource, Failure, Maintenance activities, and Maintenance cost. Maintenance variables were gathered by combining 12 reference papers and 2 handbooks about maintenance. Meanwhile, the 3 levels of maintenance implementation consist of “Poor”, “Fair”, and “Good”.

5. Results and Discussion

Data gathered was performed to achieve a better understanding of maintenance implementation in the laundry business in Jakarta Greater Area, Indonesia. The data consists of general and specific questions obtained from 35 respondents. The data are further analyzed using a simple sign test to identify the variables relating to highly effective maintenance. In addition, the relationship between variables was also studied in this paper.

5.1 General Survey Result

The survey was held during the 1st week of October 2021 and the questionnaire was spread using a direct interview with the laundry business owner and/or employees. There were 35 respondents interviewed and all of them are valid data. Valid data means that the survey questionnaire was filled by the respondents. The summary of the general data from respondents is shown in Table 2.

Table 2. Respondents General Data

		Number of Respondents and Percentage	
Business Ownership	Independent	25	71%
	Franchise	10	29%
Number of Employees	1-4	26	74%
	5-7	6	17%
	8-10	0	0%
	11-13	3	9%
Years of Operation	Under 1 year	6	17%
	Between 1-3 years	16	46%
	Over 3 years	13	37%
Operational Hours	Less than 8 hours	2	6%
	8 to 12 hours	31	89%
	More than 12 hours	2	6%
Most Frequently Error Machine	None	12	34%
	Dryer Machine	9	26%
	Washing Machine	9	26%
	Steam Iron	1	3%
	Dryer & Iron	1	3%
	Roller & Lighter	2	6%
	Cashier Machine	1	3%

Another section of the survey was about specific questions, which consists of maintenance variables. Figure 2 aims to illustrate the maintenance implementation in the Indonesian laundry business as the result of the survey.

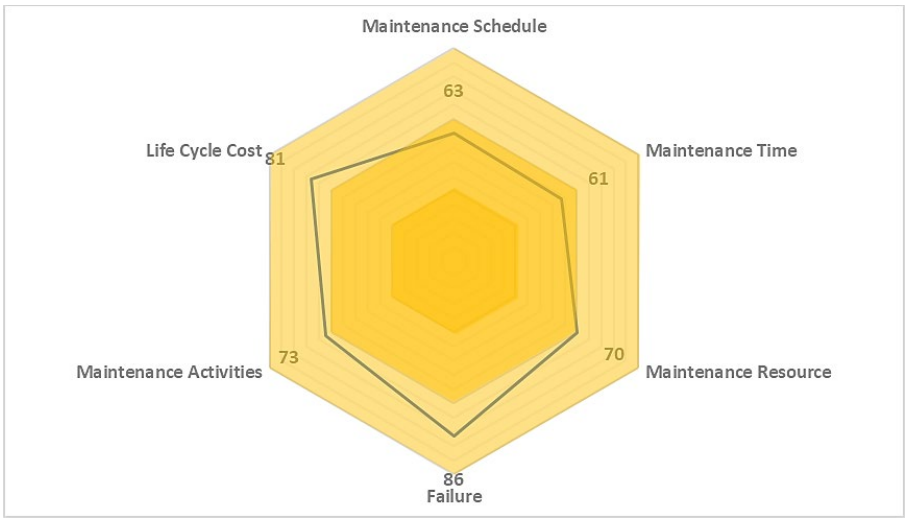

Figure 2. Radar Diagram of Maintenance Variables Implementation Obtained from Survey

A radar diagram was made based on the survey result as was divided into 6 maintenance variables: maintenance schedule, maintenance time, maintenance resource, failure, maintenance activities, and life cycle cost. From the diagram, the area 3 levels, the darker area shown in Figure 2. is the area of poor maintenance implementation. Meanwhile, the lighter area is the good maintenance implementation. The middle area is the fair maintenance implementation. A detailed explanation of each level is described in Table 3.

Table 3. Maintenance Variables at Various Levels

	Level 1 Poor	Level 2 Fair	Level 3 Good
Maintenance Schedule	Schedule unavailable	Schedule available but not well executed	Schedule available and well-executed
Maintenance Time	No time allocated for maintenance	Time allocated for maintenance but not well executed	Time allocated for maintenance and executed as per plan
Maintenance Resource	No available resource to do maintenance	Resource available but the low capability	Resource available and skilled
Failure	Machine breakdown at least every month	Machine breakdown once in 2-6 months	Machine breakdown at least once a year
Maintenance Activities	No maintenance activity	There is maintenance activity but without procedure	There is maintenance activity and procedure well executed
Life Cycle Cost	No budget for maintenance	The budget for maintenance is always lower than actual	Budget for maintenance executed as per plan

5.2 Analysis of Significance Factors of Maintenance Variables

The significance test was performed to identify the maintenance variables to “Good” level implementation of maintenance in the laundry business. Tests were carried out using a t-test: two-sample assuming unequal variances for all maintenance variables scores collected from interviews with business owners and employees (Cramer, 1998). The analysis was performed by using a data analysis tool in Microsoft Excel with a 95% confidence level. If the p-value is lower than 0.05 ($\alpha = 0.05$), then the maintenance variable is significantly related to the “Good” level of maintenance implementation. The results of the analysis show that only 3 factors are strongly associated with the "Good" level of maintenance implementation, there are Maintenance resources, Maintenance cost, and Failure. While the rest of the maintenance variables are not strongly associated with a "Good" level of maintenance implementation. The analysis result is shown in Table 4.

Table 4. Maintenance variables are associated with the "Good" level of maintenance implementation.

No	Maintenance Variables	*p*-value	Significance
1	Maintenance Resources The availability and capability of maintenance resources	0.5	Y
2	Failure The frequency of equipment breakdown occurs	0.00001	Y
3	Maintenance Cost Maintenance budgeting and cost control	0.02327	Y
4	Maintenance Schedule The availability of maintenance schedule and the compliance to execute it as per schedule	0.10669	X
5	Maintenance Time Time allocation and execution for maintenance activities	0.05928	X
6	Maintenance Activity The existence of maintenance activities and compliance to the SOP	0.26028	X

Note: X = the variables are not significantly related to the "Good" level of maintenance implementation; Y = the variables are significantly related to the "Good" level of maintenance implementation

5.3 Analysis of Correlation between Maintenance Variables

In this section, the correlation test was made to understand the relationship between maintenance variables. Table 5 shows that the highest number represents the strongest relation, which is Maintenance Time and Maintenance Schedule. Meanwhile, the correlation with the lowest value is between Maintenance Activities and Failure.

Table 5. Correlation between Maintenance Variables

	Maintenance Schedule	Maintenance Time	Maintenance Resource	Failure	Maintenance Activities	Life Cycle Cost
Maintenance Schedule						
Maintenance Time	0.936					
Maintenance Resource	0.450	0.479				
Failure	0.340	0.386	0.057			
Maintenance Activities	0.387	0.427	0.627	0.028		
Life Cycle Cost	0.287	0.304	0.039	0.445	0.170	

Glossary:

- A correlation value lower than 0.399 is considered **low**
- Correlation value between 0.400 – 0.599 is considered **moderate**
- A correlation value between 0.600 – 1.000 is considered **strong**

6. Conclusion

Data gathered in this paper was performed to achieve a better understanding of maintenance implementation in the laundry business in Jakarta Greater Area, Indonesia. The data consists of general and specific questions obtained from 35 respondents. The data are further analyzed using a simple sign test to identify the variables relating to highly effective maintenance. The survey result was classified into 6 maintenance variables: maintenance schedule, maintenance time, maintenance resource, failure, maintenance activities, and life cycle cost. It is shown that maintenance schedule and maintenance time has fair implementation among the laundry business that we had surveyed. Meanwhile, maintenance resources, failure, maintenance activities, and life cycle costs are well implemented in the laundry business. The data is then processed using the Cramer t-test resulting in the analysis that shows only 3 factors are strongly associated with the "Good" level of maintenance implementation, there are Maintenance resources, Maintenance cost, and Failure. While the rest of the maintenance variables are not strongly associated with a "Good" level of maintenance implementation. In addition, the correlation test was made to understand the relationship between maintenance variables. It is shown that the strongest relationships are Maintenance Time and Maintenance Schedule. Meanwhile, the correlation with the lowest value is between Maintenance Activities and Failure. Since this research is limited to actual maintenance implementations, it is

suggested to have further research concerning factors influencing the maintenance planning behavior and capture in a more financial point-of-view.

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Biography

Fery Permadi is a master's degree student in the Industrial Engineering department at Universitas Indonesia, concentrating in Industrial Management. He earned his bachelor's degree from Universitas Sriwijaya, Indonesia, majoring in Chemical Engineering. His working experience has been more than 10 years. He has worked for several positions, from Production Team Leader, Operational Readiness Manager (Acting), Change Team for Accelerated Transformation Program, Capital Project Engineer, and currently worked as Business Process Improvement Manager in the Supply Chain function at one of the Multinational Beverage companies in Indonesia. He is also a member of the International Supply Chain Education Alliance (ISCEA) and certified as CSCA. He is also certified as a Lean Six Sigma Green Belt holder from SSCX Jakarta.

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