

# **Analysis of Maintenance Management Implementation on Automotive Manufacturing in Indonesia (Case Study: Jakarta and West Java)**

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## **Abstract**

Maintenance management is an essential part of a company that functions to ensure all equipment runs properly. Many factors can affect the maintenance management of a company. This study discusses the implementation of maintenance management carried out by automotive manufacturing companies in Indonesia. Based on the literature review, there are nine variables to implemented maintenance management such as maintenance organization, policy, and maintenance concept, planning and control, human resources, maintenance facilities and technology, commitment and participation of top management, type of maintenance strategy, maintenance outsourcing, and history of failures. From the survey, we know that some automotive industry companies in Indonesia have good implemented maintenance management. One variable that needs to be improved is human resources because some companies do not give sufficient training for maintenance personnel supporting their works.

## **Keywords**

Maintenance Management, Automotive Industry, Maintenance, Maintenance Strategy

## **1. Introduction**

Maintenance management is very crucial for every company, be it offices or factories. The forms of maintenance can vary from simple to complex. Maintenance of equipment is needed because the goods produced' efficiency and quality will decrease over time, and machines can often fail. Maintenance management functions as a support for companies in maintaining their productive assets in order to keep working such as factories, equipment, machines, vehicles, etc. There are many divisions from the aspect of strategy, policy, type, and form of maintenance. However, in most of the literature, maintenance is divided as planned and unplanned, making its main divisions (Mehmeti et al., 2018). Some important factors in a company's maintenance management are human resources, maintenance schedule and maintenance organization (Fatoni & Nurcahyo 2018; Nurcahyo et al. 2016 and Naji et al. 2019). (Mehmeti et al., 2018).

Indonesia's economy can grow largely due to three industries, namely agriculture, mining, and manufacturing. The manufacturing industry plays an essential role in contributing to Indonesia's economic growth towards the National Gross Domestic Product, employment, and exports. One of the sub-sectors in the automotive industry (Nurcahyo and Wibowo 2015). Companies that engage in the automotive sector play an essential role in improving the Indonesian economy, and even the automotive industry also plays a role as a pioneer in the growth of the manufacturing industry in Indonesia (Bintang et al., 2019). Apart from being a leading industry in Indonesia, the automotive industry must also compete with the automotive industry from other countries such as Malaysia and Thailand. To support the smooth running of every activity carried out by the companies, maintenance management is critical to be implemented within the company.

### **1.1 Objectives**

Based on the background, the objectives of this study are:

1. Identify the important variable in maintenance management on the automotive industry.
2. Analyze the implementation of maintenance management in automotive manufacturing companies in Indonesia.

## 2. Literature Review

### 2.1. Automotive Industry in Indonesia

The manufacturing sector has long been the main key driver of the Indonesia economy. In recent years, the national automotive industry has shown quite attractive developments. According to the National Gross Domestic Product 2018, the manufacturing industry had increased from 3,68 % in 2017 to 4,24 % in 2018. It is increasing in the automotive industry, pushing the manufacturing industry's growth in Indonesia (Nurchahyo & Wibowo, 2015).

According to Wicaksono & Priyadi (2016), Sub industries of the automotive industry in Indonesia divided into four sub-industries as below:

- Principal Automotive Manufacturer
- Coachwork (Including Trailer & Semi Trailer) Manufacturer
- Auto Parts & Component Manufacturers
- Aggregate Automotive Manufacturer

According to report from Indonesia's Central Agency on Statistics (2019) that showed in the table 1, the data of increasing number of domestically assembled motor vehicle (units) from 2016 to 2018.

Table 1. Increasing Domestically Assembled Motor Vehicles Indonesia (2016 - 2018)

Kind of Motor Vehicles	2016	2017	2018
Cars	285.304	280.504	286.977
Jeep 4x2	663.794	681.942	744.693
Jeep 4x4	19.378	19.910	24.133
Bus	4.769	2.550	3.660
Trucks	204.552	231.709	284.480
Motorcycles	6.215.350	6.320.790	6.383.108

In Indonesia, the location of the automotive company is dominated in Jakarta and West Java province. Most economic activity is located in a capital city that is supported with sufficient infrastructure and distribution cost, which is cheaper than other cities. Since 1970, the government has built the industrial cluster as a long-term project from several ministries, involving Jakarta as the capital city and West Java as the closest province to Jakarta (Kwanda, 2000). These two areas have many potentials to build as industrial clusters, as the province has resources potentials, skilled human resources, service support industry, market segment, and oil and gas resources (Winardi et al., 2017).

### 2.2. Maintenance Management

With the increasing production of assembled motor vehicles, it is important to automotive industry manufacturers or components manufacturers to implement maintenance management to ensure the organization's productivity and efficiency to fulfill demands from customers in the automotive industry. According to Jin et al. (2016), the evolution of maintenance more than any others management discipline due to the increasing complexity of manufacturing equipment and processes. Various maintenance strategies have been developed, such as reactive maintenance (RM), preventive maintenance (PM), and condition-based maintenance (CBM).

According to Moubrey (1994), Kelly (1997), Wolfson Maintenance Eng Ltd (2001), the contribution of maintenance management to the performance of manufacturing systems is to ensure that the equipment in the plant can perform according to their function or can perform as organization expectation, maintenance management can be achieved by balancing maintenance resources and the plant output (Cholasuke et al., 2004).

### 2.3 The Variable of Maintenance Management

Maintenance measurement is needed to give the maintenance manager quantitative information the extent to which maintenance goals can be reached and what action needs to be taken. It is fair to state that the ultimate reason for maintenance management is to maximize the business profit, therefore identifying the factors as crucial ingredients of successful maintenance management needs to be conducted (Cholasuke, 2004).

Based on the literature review, authors identify nine important variables of measurement as a foundation of maintenance management:

1. Maintenance organization.  
The variables describe the organization of maintenance function, whether it is centralized or decentralized, or technical department integrated into manufacturers' production. Maintenance organization also defines the hierarchy in maintenance management itself, as the organization can consist of a skilled worker, middle management, senior management, and up to top management (Chinese & Ghirardo, 2010).
2. Policies and maintenance concepts.  
The variables define the activity how frequently the corrective maintenance, preventive maintenance, and condition-based maintenance were conducted in the organization. The concept of maintenance is also related to Total Productive Maintenance (TPM) in the organization (Chinese & Ghirardo, 2010).
3. Planning and control.  
Maintenance planning is derived from maintenance methods (curative or preventive). Planning and control set up some details related to maintenance operations, such as spare part stock management, calculation of cost, the use of maintenance system (and software) in planning, scheduling, budgeting, and data filing. The details become the part of maintenance activities that need to be set for a timely basis (Chinese & Ghirardo, 2010; Naji, et al. 2019).
4. Human resources.  
Human resources play an essential role in describing the knowledge and expertise of the maintenance workforce team. Details about these variables including the education level of the organization's member, length of work that represent the expertise, list of skills that need to be upgraded (such as root-cause analysis, design, purchasing process). The team must ensure sufficient resources in every maintenance activity (Chinese & Ghirardo, 2010; Fatoni & Nurcahyo, 2018).
5. Maintenance facilities, technology used and software.  
This variable the value of appropriate maintenance facility and the presence of condition-based maintenance by using the CMMS or other software. Practical information management creates the successful practice of maintenance since its transforming data to provide the report of current maintenance status (Cholasuke, et al. 2004; Chinese & Ghirardo, 2010; Naji et al., 2019).
6. Commitment to maintenance issues (include top management) & participation in maintenance strategy formulation.  
The variables describe the professional attitude towards maintenance problems or issues in the form of real presence in the formulation of maintenance strategies, in which that top management need to see the connection between maintenance and profitability (Jonsson, 1997).
7. Types of maintenance strategies (Corrective, Predictive, TPM)  
Types of maintenance strategy that used, (Corrective, Predictive, or TPM (Total Productive Maintenance)), to achieve the company's goal and increasing business production for company growth (Jonsson, 1997).
8. Maintenance outsourcing (Strategic partnership, Degree of maintenance)  
This variable explores the partnership strategy with third party responsible for maintenance activities and determines the degree of failure that needs to be handled internally or by third-party. Third party also responsible for providing the physical assets and regular inspection had the organization cannot provide, which stated in terms of agreement (Gebauer et al. 2008; Govindra & Sinulingga, 2017; Rahayu et al. 2019).
9. History of failures.  
The organization's activities to keep the data on the history of the failures for more accessible data and machine repairing in case the same failure occurs after approximately the same period. The record of failures could also be integrated with CMMS of maintenance software (Mehmeti et al., 2018).

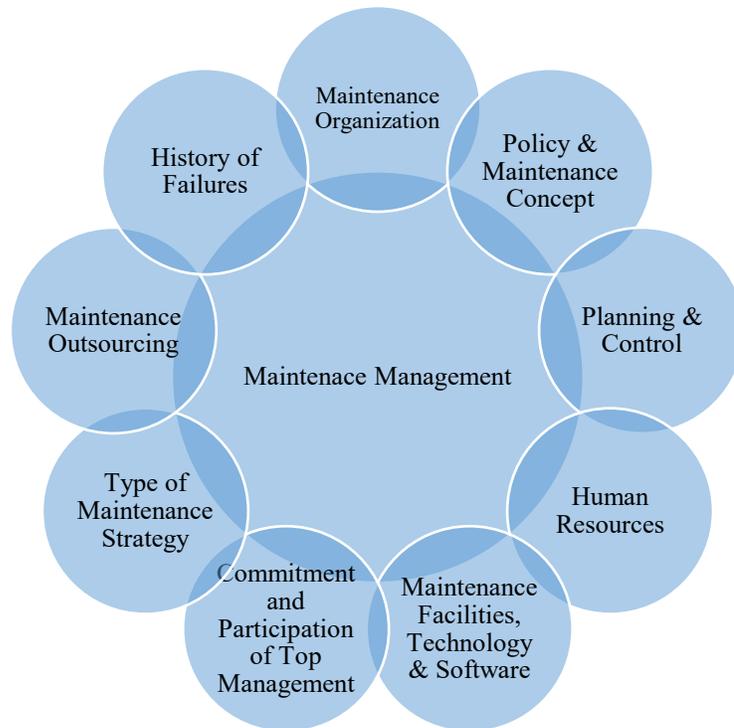


Figure 1. Theoretical Framework for Maintenance Management Automotive Industry in Indonesia

### 3. Methods

The method used in this study is a literature study from various journals related to maintenance management and conducting survey. According to Fink (1995), a survey is an information collection system that will be used as material to describe, compare, explain the phenomena under a context in order to gain knowledge and insight. The research methodology as below:

1. Literature Review  
The results of literature review were used to prepare questionnaire survey, as a means of collecting quantitative data, was conducted to produce variables which important to maintenance management implementation in automotive industry.
2. Questionnaire Development  
The questionnaire designed in this survey consists of two parts which are General information and Maintenance management measurement. General information consists of question that will provide general information from respondent such as name, age, current position, duration of works, total employee, etc. Maintenance management measurement consist of question that are in accordance with purpose of this study. Total there is 9 category or variables of maintenance management implementation and 27 question in this questionnaire.
3. Data Collection  
The survey was sent to all people who know implementation of maintenance management in their company, especially in automotive industry. Total there is 30 responses from all respondent and then sorted by relevancy of industry and 1 survey each company, so total there is 20 responses which is considered valid.
4. Data Analysis  
Data analysis from questionnaire then were analyzed to describe the status of current maintenance management implementation in automotive industry Indonesia

#### 4. Results and Discussion

The demographics of the 20 respondents who filled out the survey are as shown in the table 2 below:

Table 2. Demographics respondent sort by Age

Age	Total	Percentage
> 44 years old	2	10%
25-34 years old	15	75%
35-44 years old	3	15%
Grand Total	20	100%

From table 2, we know that almost all respondents age between 25 until 34 years old with percentage 75%, and 15% respondents age between 35 until 44 years old, and 10% or respondents ages more than 44 years old.

From table 3, we know that almost all respondents or around 80% are working in the maintenance department as maintenance manager, maintenance supervisor, and maintenance staff. From table 4, we know that their last education is mostly diploma or bachelor's degree, and almost the respondent has worked more than five years in the automotive industry in Indonesia.

Table 3. Demographics respondent sort by current position

Current Position	Total	Percentage
Others	4	20%
Maintenance Manager	2	10%
Maintenance Staff	5	25%
Maintenance Supervisor	9	45%
Grand Total	20	100%

Table 4. Demographics respondent sort by last education

Last Education	Total	Percentage
Diploma or Bachelor	16	80%
Master Degree	2	10%
Senior High School or Vocational High School	2	10%
Grand Total	20	100%

Table 5. Demographics respondent sort by working experience

Years of Experience	Total	Percentage
< 5 years	5	25%
> 10 years	3	15%
5 - 10 years	12	60%
Grand Total	20	100%

Size company which become object of study shown in figure 2.

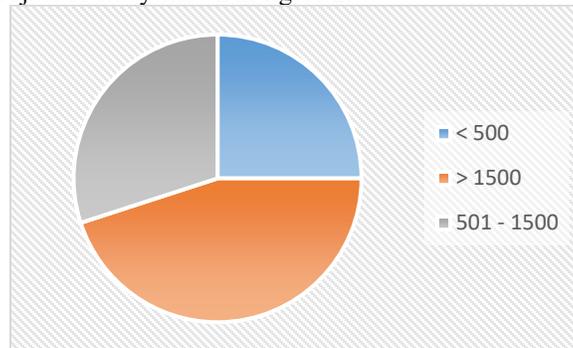


Figure 2. Company Size

From nine variables that described above, we have highlighted numbers based on our survey as following below:

**1. Maintenance organization.**

Based on the survey, almost all of company have dedicated maintenance department. Only one company does not have maintenance department. Detail as shown in figure 3.

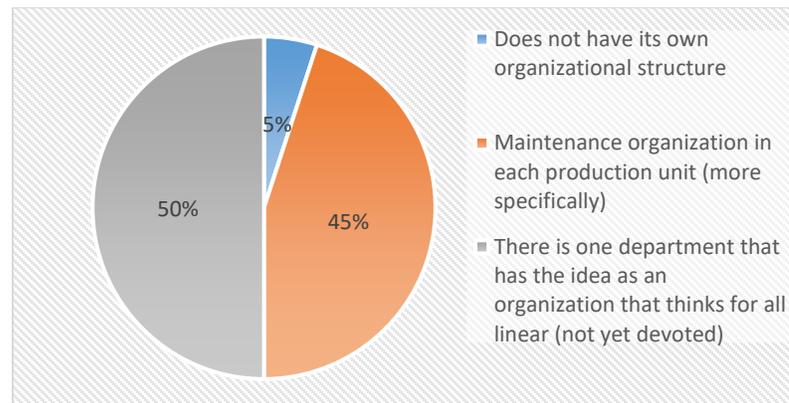


Figure 3. Maintenance organization questionnaire results

Maintenance organization is important to give direction for the maintenance operation. By having a clear maintenance organization, an automotive company in Indonesia, especially in Jabodetabek area, will have a clear path of work and information flow and roles and responsibilities for maintenance personnel.

From the survey result, some companies that do not have maintenance organizations are classified as small companies with employees less than 500, company with have employees >500 people have maintenance organizations in the company.

**2. Policies and maintenance concepts.**

Almost all the company have policies regarding maintenance. That policy is used as guidance for maintenance activity, with one company has policy but does not utilize that policy as guidance. 55% of top management companies involve and endorse on policy formulation. From that data, we conclude that there are support from top management to support maintenance activity in their company.

Within the policy and maintenance concept, the maintenance department's operation in the automotive company will work effectively because it will ensure maintenance activity. Furthermore, this will support the target of production and increase the profitability of the automotive company.

### 3. Commitment to maintenance issues (include top management) & participation in maintenance strategy formulation.

Based on the survey, almost all of company (75%) have high commitment on maintenance issues. As shown in figure 4.

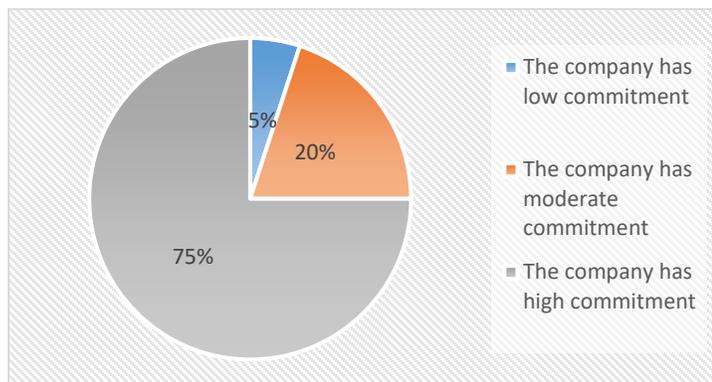


Figure 4. Company's Commitment to Maintenance

The survey emphasizes management commitment to the maintenance goals and strategy formulation participation to be present to make the integrated system work. If not, it could cause attitude and communication problems, especially between operations and maintenance, are can be serious to achieve effective maintenance. Moreover, communication between maintenance, production supervisors, and representative personnel is essential for reaching successful maintenance (Johnson, 1997).

### 4. Types of maintenance strategies (Corrective, Predictive, TPM).

From the survey we know that 90% of companies used oral and written to socialize their maintenance strategy to the employee. and from the survey we know that 80% of companies apply Total Productive Maintenance (TPM) as their maintenance strategy as shown in figure 5.

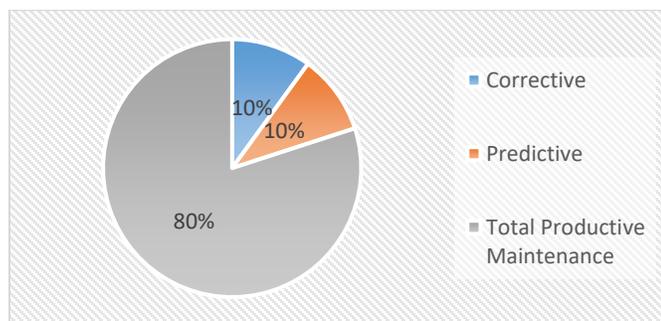


Figure 5. Type of Maintenance Adopted by Automotive Industry in Indonesia

Within the survey, companies have implemented TPM and informed to employee clearly. Hence, it will mark their integrity regarding company's commitment to achieve their goal and increasing production, since Total Productive Maintenance has its philosophy on aiming to negate breakdown, small stops, defects, and accidents to achieve almost perfect production.

### 5. Planning and control.

- 75% of companies have certain schedule and time range without waiting issues appeared.
- 70% of companies have documentation and system regarding maintenance activities.
- 90% of companies have spare-part control management and documentation for maintenance purposes.
- Only 45% of companies have proper amount for maintenance purposes, while the remaining half have limited amount.
- Almost 50% of companies have optimal improvement for reducing maintenance cost, while other companies do not have optimal improvement.

- 90% of companies do root cause analysis and appropriate actions, while others do root cause analysis without appropriate actions.

Maintenance planning needs is very crucial in the early stages of maintenance. planning regarding costs, the amount of spare part stock and maintenance schedule. It should be done as detailed as possible. When the maintenance process has been running, strict control is also needed to ensure that the plan that has been prepared in advance, running well and does not cause problems such as unnecessary expenses, excessive spare part shortages and chaotic maintenance schedules.

#### 6. Human resources.

- Only 60% of companies have organized appropriate training for their employees as shown in figure 6.
- 70% of companies have employee who understand their job description, while 60% of companies have outside job description
- 80% of companies have maintenance manager by holding diploma/bachelor degree.
- Almost all maintenance manager (80%) have more than 10 year experience in their company, but only 30% of companies have maintenance manager with more than 10 year experience in their position.
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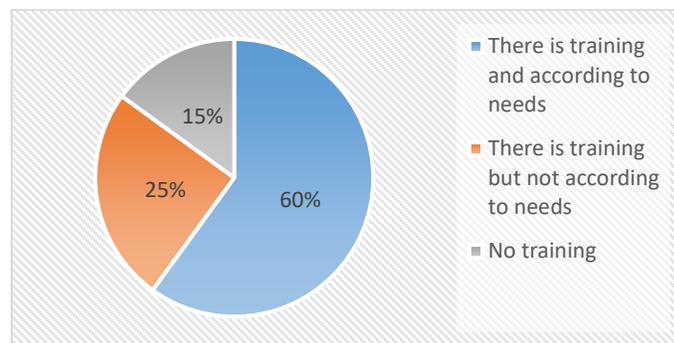


Figure 6. Training Mapping Result from Questionnaire

Training is an essential need for maintenance staff from operators to the managerial level. Appropriate training needs to be carried out to improve technical skills and company maintenance management. With the maintenance staff's qualified skills, the equipment will last longer and can work more optimally. Besides training activity, the company also needs to be aware of job descriptions to prevent the specific work done by the manpower who do not have specific skills, which could result in failure or accident.

#### 7. Maintenance facilities, technology used and software.

All companies have the same view that IT for maintenance management is important. In contrast, only 10% of them have applied Computerized Maintenance Management System (CMMS) in all maintenance activity, 70 % of company have used CMMS but not effectively used as shown in figure 7.

85% of respondents agreed that their facilities sufficiently to support all maintenance activity in their company.

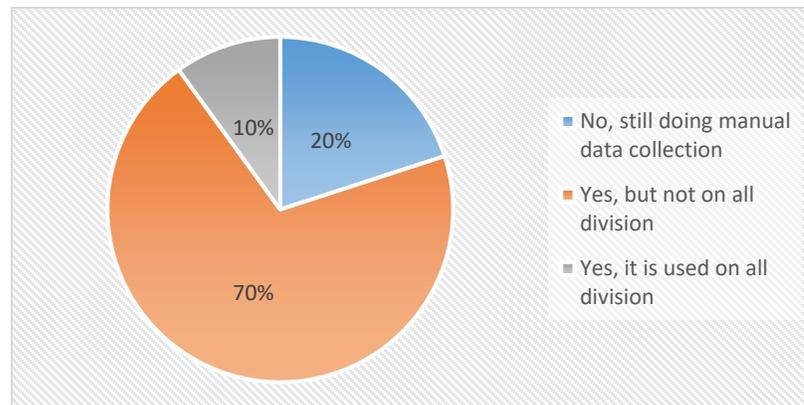


Figure 7. Application of Maintenance Software (CMMS)

Automotive companies in Indonesia are not familiar with computerized maintenance management systems (CMMS) even though maintenance management is important. Although human resources responded to agree that the current facility supports their maintenance activity, to improve, more companies need to consider using computerized maintenance management systems (CMMS) to ensure that all the maintenance data were integrated and tracked down historically.

#### **8. Maintenance outsourcing (Strategic partnership, Degree of maintenance).**

- 90% of companies are still using outsourcing for maintenance management
- 55% of companies have 5-8 criteria of choice outsource, 30% have 1-4 criterias, and others have more than 8 criteria
- Only 60% of companies have considered outsource historical performance as their requirements, while others compromise some of highlighted outsource historical performance.
- Only 45% of companies have certain schedule while using outsource for maintenance management.

From the result, automotive companies have set criteria for choosing the outsourcing service; this criteria is important to ensure that the maintenance activity that has been done by the outsourcing service to meet the standard requirement of what company is requested. Many companies still use outsourcing services due to some maintenance activities not being able to be done by the workforce in the company. Another factor to consider is that the outsourcing service has several machine equipment or workforce with a skill set to conduct maintenance activity in the company.

#### **9. History of failures.**

- All companies have documentation of failures but 15% of them do not include into periodic supervision.
- 60% of companies use system for documentation, while others still use manual documentation.

From the history of failures result, we can conclude that all automotive company in Indonesia, primarily located in Jakarta and West Java have the awareness to record the failure which occurred in the company. The companies are aware of the good recording of failure data that will make them easier to maintain and repair the facility or equipment, resulting in minimizing breakdown time and improving its productivity. To improve a history of failures, they could upgrade their system from manual to automation and conduct the data's periodic supervision.

This paper discussed automotive industry companies in Indonesia that have commitment and dedication to maintenance management, as mentioned in the previous section. However, we marked variable human resources since they play an important role in describing the maintenance workforce team's knowledge and expertise. On variable Planning and Control, only 45% of companies have proper maintenance purposes, while the remaining half have a limited amount. Also, only 50% of companies have optimal improvement for reducing maintenance costs, while other companies do not have optimal improvement.

Although the management commitment has shown good result from this paper, a successful maintenance program implementation is not the result of just organizational commitment (Diaz-Reza et al., 2018). It is essential to explore the impact of other factors in this research: organization, planning, machinery, digital technology, employee commitment, employee education and training, data history, and outsourcing.

### **5. Proposed Improvements**

Although companies have the commitment and dedicated division for maintenance management, we have proposed improvements as below:

- a. More training needed to be held by Human Resources Division. Although we do not discuss the impact for companies, having well-trained employees is important for long-term company competitiveness.
- b. Companies need to extend their budget for maintenance purposes, such as spending more budget to reduce human error on documenting failures or investing in the digital system for data history.
- c. Use more internal company resources for maintenance purposes, since it will reduce the company spending their budget through maintenance management.

### **6. Conclusion**

This study identifies several variables that can describe maintenance management in the automotive industry in Indonesia. We highlighted human resources as the main concern to be improved for the implementation from the nine variables that we studied. The use of the software is ineffective in recording the historical of failure.

The study is only limited to small numbers of respondents compared to the number of automotive companies in Indonesia, especially Jakarta dan West Java. The source of variables is only limited from the literature review. In the future, we suggest that similar research could expand the number of respondents. The location of study could be expand since Indonesia has a wide range of industrial areas. Future research could also get insight from experts to determine the variables to complement the literature's variables.

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