

Maintenance Practices in Indonesian Wood and Furniture SMEs: Survey Results

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Abstract

The importance of maintenance arises over time due to the more advancement in technology and the higher demands where downtimes could ruin the business. The proper maintenance management will maximize the business profit and also offer a competitive advantage. This paper aims to identify the key ingredients of successful maintenance practices within the Indonesian wood and furniture industry through a survey of 35 industries. The t-test results show that all factors are significantly related to highly effective maintenance management. To study the relationship between maintenance success factors, the Pearson-correlation test was applied. The results show three strong correlations, i.e., the maintenance planning and scheduling - organization; maintenance approach - maintenance planning and scheduling; and maintenance approach - financial aspect. These three strong correlations can be an effective maintenance strategy to reduce the risk of tool and machine failure. A radar diagram shows the average status of maintenance management in the Indonesian wood and furniture industries. It shows that, on average, the respondents were “excellence,” who are fully or almost entirely adopting proper maintenance practice and have excellent performance in that particular aspect. On average, the respondents are fully aware of the maintenance practice importance as fundamental for their business success.

Keywords

Maintenance management, Survey, Indonesia, Furniture industry, Maintenance approaches

1. Introduction

The approach of maintenance in the early days was corrective approach “fix it after fails” due to simple machines in production and the demand level on that day was not so high. Advancement in technology has shifted the maintenance approach from corrective to preventive maintenance. The importance of the maintenance arises over time due to the more advancement in technology and the higher of demands where down times could ruin of the business (Ayo-Imoru and Cilliers 2018). Nowadays, maintenance plays a key role to achieve goals and objectives in organization. The functions of maintenance are to serve and support organization’s primary process (Alyouf 2009). Maintenance has contribution for reducing equipment’s downtime, improving product’s quality and increasing productivity (Shyjith et al. 2008). Organization’s profit, quality, and service can be increased with the proper of maintenance practices within 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). Therefore, the proper maintenance management is needed within organization due to substantial effect on operational cost. Maintenance management plays a role to ensure performance of plant according the condition that organization expected. It can be reached if the allocation of maintenance resource and the output are balance (Cholasuke et al. 2004). Effective maintenance management helps organization to increase performance of equipment and plant capacity that which will increase revenues within organization. Ineffective maintenance management lead to decrease productivity as well as profitability. Based on Cholasuke et al (2004), the proper maintenance management will maximize the business profit and also offer competitive advantage.

One of Indonesian strategic sectors that has shown a competitiveness in global market is furniture industry. According to Cabinet Secretariat of Republic of Indonesia (2019), export performance of Indonesian furniture

industry shows a positive trend in the last three years, i.e. US\$ 1.60 billion in 2016, US\$ 1.63 billion in 2017 and US\$ 1.69 billion in 2018. Indonesia has a great potential raw material which contributes 80 percent of the rattan in the world market (The Jakarta Post 2019). The better product's quality of Indonesian furniture industry is needed to compete in global market as well as improve country's economy through furniture exports. A proper maintenance practices would improve the business performance through the impact on quality, efficiency and effectiveness of operation. Further, it can improve the competitiveness in global market through productivity and value advantages (Alsyouf 2009). Thus, the aim of this paper is to identify the factors that are the key ingredients of a successful and proper maintenance practices within Indonesia furniture industries. An empirical approach was employed via a furniture industry survey that involved the participation of furniture industry professionals within large industry and SMEs.

This paper is organized in five (5) sections. The first section is the introduction. The second section explores maintenance measurement. The third section explains the research methodology. The fourth section explains and discuss the key findings of the survey. The last section is the conclusion and discuss the further work.

2. Maintenance Measurement

According to Cholasuke et al (2004), maintenance measurement is needed to get the quantitative information on maintenance goals and what maintenance action to be taken due to enhance the performance in operation function.

2.1 Organization

Maintenance is combination of technical administrative and managerial actions of an item during their life cycle which can help the item to run as required function (Alsyouf 2009; Grusenmeyer 2014). Therefore, an organizational factor should be considered primarily in the aspect of maintenance (Cholasuke 2004; Chinese and Ghirardo 2010). An organizational factor will analyze how the organization regulates the maintenance aspect within the organization and the influence of the policies in maintenance performance.

2.2 Maintenance Planning and Scheduling

Planning and scheduling of maintenance help organization for minimize maintenance cost. Scheduling of maintenance within organization are propose to determine a detailed maintenance plan which can provide the reliability of system with minimum cost (Tuyet and Chou 2018). Planning and scheduling can make activities which relate to maintenance task and resource allocation more effective. Lack of planning and scheduling can decrease the main function of maintenance to serve organizational needs. Maintenance planning contributes positively in effective maintenance activity (Nurcahyo et al. 2019). High responsiveness in business function with minim maintenance cost is the result of the proper planning and scheduling of maintenance (Levitt 1997; Coopers and Lybrand 2001; Cholasuke et al. 2004).

2.3 Financial Aspects

Maintenance management within organization have a main function to achieve optimum performance in operation with minimum cost (Moubray 1994; Kelly 1997a; Wolfson Maintenance Engineering Ltd 2001). Financial aspect in maintenance includes budget of maintenance, cost of material and labour. A proper financial management in maintenance function will resulting in lower variation between budget and cost of maintenance. Further, maintenance cost has impact in revenue within organization (Muyingo 2017).

2.4 Maintenance Approach

According to Alsyouf (2009), maintenance approach has several forms such as breakdown maintenance, preventive maintenance and condition-based maintenance. However, each of industry needs to select the appropriate maintenance approach which will enable to maintain stable production capabilities and enhance performance within organization. For small and medium-sized firms, preventive maintenance approach can help improve firm performance due to highly effective, optimum cost and positively correlated to quality and safety performance (Chinese and Ghirardo 2010).

2.5 Human Resources Management

Human resources are important in maintenance function which have impact in manufacturing and production system (Sheikhalishahi et al. 2019). Labour plays an important role as maintenance resource to manage, plan, supervise and execute all maintenance activities. Effective human resource management will be resulting in successful of maintenance management (Nakajima 1988; Groote 1995; Kelly 1997b; Jonsson 1997; Kirby 2000, Ingalls 2000). Generally, human resource will impact on single performance and represent organization's vision of maintenance. Training also significantly and positively contributes to maintenance performance, in terms of maintenance processes efficiency and effectiveness (Fatoni and Nurcahyo 2018).

3. Research Methodology

To achieve the research objectives, the required data were obtained using a survey. A survey collects information to describe, compare, and explain: practice, knowledge, behavior, or attitude (Fink 1995). The steps taken in this study are as follows:

3.1 Literature Review

Indonesia's definition of Small and Medium Enterprises was set out in the Micro, Small, and Medium Enterprise Act No. 20 of 2008. Micro enterprises have net assets (not including land or buildings) of up to 50 million rupiah and annual sales of no more than 300 million rupiah. Small enterprises can have between 50 million rupiah and 500 million rupiah in net assets (not including land or buildings) and annual sales have between 300 million rupiah and 2.5 billion rupiah. Medium enterprises can have between 500 million rupiah and 10 billion rupiah in net assets (not including land or buildings) and annual sales have between 2.5 billion rupiah and 50 billion rupiah.

In addition to this act, World Bank classifies micro, small, and medium enterprises in three ways. Micro enterprises consisting of 10 employees, small enterprises consisting of 30 employees, and medium enterprises consisting of 300 employees (Bank Indonesia 2015).

To get a good understanding of the maintenance management, a review of the literature on maintenance and a maintenance survey is required. The objectives of this literature review are:

- (1) to understand the importance of maintenance in organizations,
- (2) to formulate the variables used to measure maintenance management, and
- (3) to find data collection methods.

3.2 Survey Questionnaire Development

The questionnaire designed in this survey consists of three main parts:

- (1) General information about respondents
Questions will provide general information about participants, such as name, gender, age, address, position in the organization, and length of time working.
- (2) General information about the organization
Questions will provide general information about the participating organizations such as the name of the business unit, the business unit's address, number of workers, and the average number of products sold each month.
- (3) Maintenance measurement
Consist of questions that are important for survey purposes. Questions are categorized into five sections according to the five main ingredients (factors) of successful maintenance.

Questions are designed based on a list of maintenance performance measures (variables) formulated from the literature, as shown below.

- (1) Organization
 - a. Organization structure
 - b. Maintenance policy within organization
- (2) Maintenance planning and scheduling
 - a. Actual work accomplished / the planned work
 - b. Overtime from work time / the unplanned maintenance

- (3) Financial aspect
 - a. Maintenance expenses
 - b. Variation between maintenance budget and actual expenses
 - c. Lost production costs
- (4) Maintenance approach
 - a. Periodic maintenance
 - b. Maintenance program
 - c. Repair of tools and machines
- (5) Human resources management
 - a. Skills
 - b. Training
 - c. Job understanding and perception

3.3 Data Gathering

This pilot survey was conducted with a questionnaire distributed to be filled out online. Participants are furniture workers in Indonesia, either in SMEs or large companies. Furniture organization was obtained from field observations and information on the internet and 108 companies were randomly selected.

3.4 Data Analysis

Statistical significance tests (t-test) and studies are conducted in the study to ensure that relationship between two or more variables do exist, which are:

- (1) if there are differences in the main material maintenance factors and the size of the organization, and
- (2) if there are differences between the maintenance practices implemented by the organization.

4. Key Findings of the Survey

From 108 questionnaires distributed to 108 Indonesian wood and furniture SMEs and large enterprises, there were 34 SMEs and 1 large enterprise from wood and furniture sector responding and useful for data analysis. It was 32 percent of the total questionnaires distributed.

4.1 Participating Enterprises Segmented by Size

The survey covered every enterprise size, those are small, medium, and large. Participating enterprises were categorized into two groups: small and medium enterprises (SMEs) and large enterprises. Table 1 illustrates the percentages of enterprises participating in the pilot study.

Table 1. Participating enterprises segmented by size

	Size		Total
	SME (≤ 300 workers)	Large (> 300 workers)	
Total enterprises	34	1	35
Percentage	97,14	2,86	100

4.2 Position of Respondents

Most questionnaire respondents were owner of the businesses consist of 15 enterprises (42,86%). The marketing manager position from the enterprises consist of 10 enterprises (28,57%). The director position from the enterprises consist of 6 enterprises (17,14%). The rest were assistant owner position enterprises consist of 3 enterprises (8,57%), and design and product coordinator position consist of 1 enterprise (2,86%). Most respondents were located from Central Java, especially Jepara. The rest were from Jabodetabek (Jakarta, Bogor, Depok, Tangerang, Bekasi) and Medan.

4.3 The Key Ingredients of An Effective Maintenance Management Program

The respondents were divided into two groups, the highly effective and the relatively low effective maintenance management as rated by the respondents. The five ingredients of successful maintenance and effective maintenance management are linked to find out which factors are significantly related to highly effective maintenance management and which factors are not significantly related to highly effective maintenance management.

A simple test significance was performed to identify the factors relating to highly effective maintenance management. The student-t test is applicable if the population variance is unknown and it is more reliable when sample size larger than 30, which match with the survey conditions. The score of each factor was calculated from the score of each variable provided by the respondents, as mentioned by Cramer (1998) and Fink (1995). If the p-value is lower than 0.05 ($\alpha = 0.05$), then the factor is significantly related to highly effective maintenance management.

The student-t test was conducted with Minitab 18. Based on the student-t test output, all the key success factors resulted in a p-value of 0.000 where the value is lower than 0.05, which means that all factors determined in this survey are significantly related to highly effective maintenance management, i.e., organization, maintenance planning and scheduling, financial aspect, maintenance approach, and human resources management. There is a strong statistical significance among them. It is found that those respondents who had good organization structure and maintenance policy within the organization, such as maintenance policy communicated within the organization, maintenance policies govern the availability and service life of tools and machines have had higher effective maintenance management functions. The planned work and overtime from work time/unplanned maintenance are also important to be identified. Financial aspects such as the allocation of costs for maintenance expenses, variation between maintenance budget and actual expenses, and lost production costs have had a higher effective maintenance management function. They also had periodic maintenance and maintenance programs to reach higher effective maintenance management functions. Also, the existence of training provided to workers to improve workers' skills can increase workers' understanding and perception of their job. It could help SMEs and large enterprise had higher effective maintenance management functions.

4.4 Analysis of Correlation Between the Maintenance Success Factors

To study the relationship between maintenance success factors, the Pearson-correlation test was applied. Table 2 shows the results of the correlation study. A correlation value in the range of 0,4-0,6 is considered moderate, a higher value greater than 0,7 is considered to imply strong correlation. Based on Table 2, the maintenance planning and scheduling and organization, maintenance approach and maintenance planning and scheduling, and maintenance approach and financial aspect, these three have a strong correlation, that can be effective maintenance strategy to reduce the risk of tool and machine failure. They are all positively correlated, which means that increasing one factor increases the other.

4.5 Status of Indonesia Maintenance Management Practice

This section aims to illustrate the status of maintenance management practice in Indonesian Wood and Furniture SMEs and large enterprise from the results of the pilot survey.

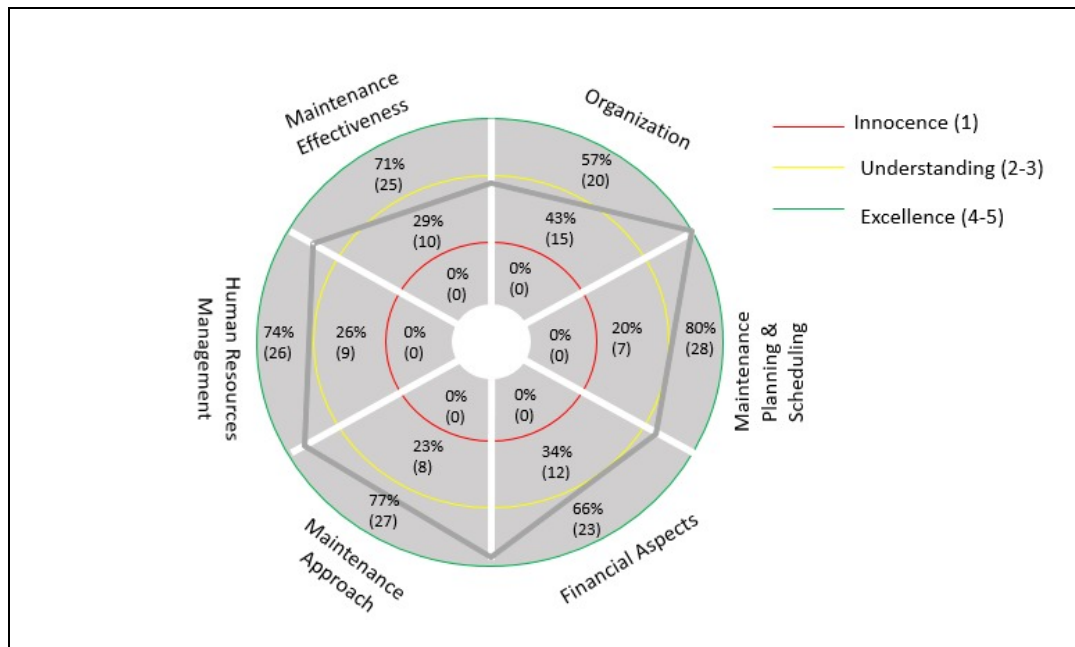


Figure 1. Radar diagram of maintenance status from a pilot survey in Indonesian Wood and Furniture SMEs

Figure 1 shows radar diagram generated based on the survey findings. The diagram is divided into six areas of measurement (one maintenance effectiveness and five key maintenance success factors). In each area, the respondents will be categorized into three groups:

- (1) Innocence.
- (2) Understanding.
- (3) Excellence.

The “innocence” (inner level) refers to those enterprises who do not adopt any good maintenance practice and do not realise any benefits from maintenance. The “understanding” refers to those enterprises who adopt some good maintenance practice and realise benefits from them, but still have rooms for improvement, and the “excellence” (outer level) refers to those enterprises who are fully or almost fully adopting proper maintenance practice and have excellent performance in that particular aspect.

The percentage shown in each sector represents the number of respondents who meet the criteria of each level. For example, in maintenance approach sector, based on the questionnaires results, 23 percent of the respondents or eight enterprises out of 35 enterprises adopt maintenance approach and realise the importance of it. A total of 77 percent or twenty-seven enterprises adopt a periodic maintenance program, the existence of maintenance to improve the performance of tools and machines, repairs are carried out immediately after damage to tools and machines is found, and so on. The criteria of each level in each sector are presented in Table 3.

Apart from presenting the categorisation of the respondents at different levels, the radar diagram also shows the average status of maintenance in Indonesian Wood and Furniture SMEs and large enterprise based on the score of the variable in each factor from the questionnaires used for the analysis. The radar diagram in Figure 1 that connect together with bold lines show the average score of a particular factor obtained from the analysis. The radar diagram shows that there is room for improvements. On average, the respondents have “Excellence” and they are fully aware of the importance of maintenance practice as a fundamental for their business success.

Table 2. Correlation between maintenance success factors

	Organization	Maintenance planning and scheduling	Financial aspect	Maintenance approach
Maintenance planning and scheduling	0,766			
Financial aspect	0,394	0,406		
Maintenance approach	0,633	0,734	0,739	
Human resources management	0,465	0,631	0,483	0,562

Note:

- A correlation value lower than 0,3 is considered **low**
- A correlation value in the range of 0,4-0,6 is considered **moderate**
- A correlation value greater than 0,7 is considered **strong**

Table 3. Key ingredients versus the maintenance performance status at various levels

	Level 3 Excellence	Level 2 Understanding	Level 1 Innocence
1. Maintenance effectiveness	Organization was rated as having very satisfied maintenance performance.	Organization was rated as having satisfactory maintenance performance.	Organization was rated as having unsatisfactory maintenance performance.
2. Organization	Job descriptions are in accordance with the organizational structure. Have written maintenance policy. Worker involved in policy setting and the policy is periodically reviewed.	Job descriptions are in accordance with the organizational structure. Have written maintenance policy. No workers' intervention in policy setting. The policy is usually reviewed.	Job description does not match the organizational structure. No formal maintenance policy.
3. Maintenance planning and scheduling	Have written, accurate and detailed production schedule. More than 80 percent work planned accomplished. Production reports are made accurately, on time, and can be accounted for to the party concerned. Have regular maintenance, inspection and repairment of production machines and materials.	Production schedule is in place. More than 50 percent work planned accomplished. Production reports are made accurately but sometimes not on time. Maintenance and inspection of machines and materials are sometimes be done.	No formal production schedules. Less than 50 percent work planned accomplished. Maintenance, inspection, and repairment are rarely be done.
4. Financial aspects	Maintenance budget is provided for maintenance of tools and machines which includes prevention of damage and repairment. Excellent budget control.	Maintenance budget is sustained. Less efficient budget control.	No maintenance budgets.
5. Maintenance approach	Have scheduled maintenance program as well as regular checks on tools and machines. Repairment of machine damage is carried out by internal parties.	Scheduled maintenance program is settled. Damage of machine occasionally repaired by external parties.	No scheduled maintenance programs.
6. Human resources management	Regular maintenance training programs for workers are provided. Job descriptions are well described and well understood. Excellent human resource management.	Maintenance training program is only presented for new workers. Job descriptions are well described. Less efficient of human resource management.	No training. Lack of maintenance skill.

5. Conclusion and Further Work

Maintenance practice is important in the wood and furniture sector. The performance of the furniture industry and SMEs cannot be separated from effective management. This study presents the results of a survey regarding maintenance practices in SMEs and the furniture industry in Indonesia. There are 5 maintenance factors, consisting of 49 variables that are included in the questionnaire. The test analysis shows that all factors are significantly related to highly effective maintenance management, i.e. organization, maintenance planning and scheduling, financial aspect, maintenance approach, and human resources management. Based on the Pearson-correlation test, maintenance planning and scheduling and organization, maintenance approach and maintenance planning and scheduling, and maintenance approach and financial aspect, these three pairs have a strong correlation which are positively correlated, that can be effective maintenance strategy to reduce the risk of tool and machine failure. The radar chart also shows that in general, Indonesia's maintenance practices fall into the "Excellence" category. This means that furniture organizations in Indonesia are already practicing good maintenance management.

This research has certain limitations in the selection of industrial areas, the number of samples, and so on. Therefore, for further research, it is hoped that the following elements can be considered in the research:

- (1) Increase the number of samples.

This study can only study a questionnaire to 35 organizations. In fact, in reality the organization of wood and furniture in Indonesia is much bigger. The greater the number of samples, the level of accuracy of the results will increase.

- (2) Conduct an interview.

Due to time limitation, this study can only conduct a survey via questionnaire without structured interviews with respondents regarding understanding of maintenance.

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