Maintenance information system development for Powerhouse Department on diesel engine manufacturer

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Abstract. The Powerhouse Department on a diesel engine manufacturer has the role of supplying electricity to all departments, especially the production department. The problem that arises is the recording of all maintenance and repair activities carried out in the logbook. The purpose of this research is to develop a maintenance information system that can record all maintenance and repair activities that can be recorded electronically. The method used is Object-Oriented Development (OOD). The results of the research are data of tools, parts & spare parts, maintenance history & engine damage, maintenance scheduling documents, and vendor & supplier data. The system was implemented on this manufacturer.

1. Introduction

This research is carried out on an industry that produces diesel engine (tractor) for agricultural tools. This industry in 2016 produced 80,000 diesel engines and in 2017 produced 98,000 diesel engines. The resulting product consists of horizontal and vertical diesel engines with a power of 6.5-14 HP, namely: Corn Sheller, Combine Harvester, Rice Transplanter, and Organic Fertilizer Processing Equipment. The running of the production process is also determined by the condition of the machine and tools, because basically the production will not run optimally if the engine condition is not optimal. This will affect production capacity and product quality. Maintenance of production tools must always be carried out as maximum as possible either planned or unplanned.

The Powerhouse Department is part of the Production Department responsible for electricity supply for the entire production process and handling the engine trouble that is in the diesel engine production line, as well as providing spare-parts for existing machines. The maintenance carried out at the Powerhouse Department is mostly applied after damage (Corrective Maintenance). The history record of engine damage and damage to the tools that is still spreadsheet-based has made it difficult to monitor engine damage, tools damage, or component replacement.

In connection with the matters above, basically the management of maintenance in the Powerhouse Department has been arranged according to the maintenance work procedures. But the implementation of maintenance management has not been carried out properly. In order to overcome the problem of maintenance management in the Powerhouse Department, it is necessary to have a maintenance information system that can integrate the work of overcoming engine problems, providing spare-parts, replacing components, inspecting the machine, and tools conditions.

The problem that occurs in the Powerhouse Department is: the history record of machine damage and tools damage is done manually into the recording log in the form of a spreadsheet. However, the
recording log is rarely used, preventive maintenance reports are not carried out, technician actions are not reported to the section head, patrols at each line by officers are not carried out, tools inventory and spare-parts are not controlled.

The creation of this maintenance information system aims to improve the maintenance management in the Powerhouse Department. The system will make it easier to manage maintenance scheduling and provide maintenance recommendations on a machine.

2. Literatures review
According to Whitten and Bentley [1], information systems are the settings of people, data, processes and information technology that interact to collect, process, store and provide information needed to support an organization. According to Rochim [2], information systems can be interpreted as a unit of information elements, including how to design, activate, handle, maintain, and utilize information. The needs of maintenance information system will increment efficiency, security, reliability and availability, and will simultaneously reduce operational cost of maintenance too [3]. Maintenance must be carried out to replace, repair and service an identifiable set of manufacturing components. The need of maintenance is to maximize the availability of machinery and tools for production [4]. Good maintenance system must cover: preventive maintenance, corrective maintenance, and maintenance quality control [5]. CRUT model for information maintenance are connected to Control, Reliability, User Participation, and Training to each other. The element of control will lead to efficiency and determine the effectiveness of the systems. The elements of reliability, user participation, and training are included in the proper control of an organization's IS [6]. The goal of maintenance management procedure is the improvement of action based on data analysis from processes and indicators. This will improve overall efficiency in the service of an organization and avoiding costly downtime [7]. Attention to facility management determines competitive, because there is a reduction in costs and added value to the business init. Data from the department of maintenance in the plastic industry incorporated in a computerized maintenance management information system can provide information relevant to workers responsible for repairing machinery. Also management of the company can help them make the right decisions [8]. The management of maintenance is complex and has a significant impact on the profitability of the business, so computer-based supports for achieving successful implementation of these systems [9].

3. Methods and results

3.1. Time and place of research
This research was carried out in September - October 2017 at a joint venture diesel engine company located in Semarang, Central Java, Indonesia

3.2. The method
The method used in making this system is the method proposed by Britton and Doake [7], Object Oriented Development (OOD) which includes stages: Inception, Elaboration, Construction, and Transition. This system built with all of stages that Britton and Doake proposed. The result of each stages are:

3.2.1. Inception stage. This stage includes collecting data from interviews with one of the technicians in the Powerhouse Department. The results of data acquisition are related to machine and tools maintenance scheduling consisting of data: tools, parts & spare parts, engine maintenance & engine damage history, maintenance scheduling documents, Vendors and Suppliers.

3.2.2. Elaboration stage. This stage includes Modeling (UML) in the form of: Use Case Diagram (Figure 1), Class Diagram (Figure 2), Sequence Diagram (Figure 3), Collaboration Diagram (Figure 4), and Activity Diagram (Figure 5).
Figure 1. Use case diagram of powerhouse maintenance information system (PMIS).

Figure 2. Class diagram of PMIS.
3.3. Construction
This stage includes; The interface design between the user and the system is done by the user entering the name and password as shown in figure 6. The provided selection button consists of enter and cancel, then the next page will appear.
If the user logs in with a username and password as an admin, it will automatically be directed to process tools data as shown in figure 7, spare-part data as shown in figure 8, tools data as shown in figure 9, and data on tools borrowing and return as shown in figure 10.

If the user logs in with a username and password as a technician, it will automatically be directed to process machine maintenance data and tools repair as shown in figure 11.

If the user logs in with a username and password as a section leader, it will automatically be directed to process vendor data such as shown in Figure 12, and supplier data as shown in figure 13.

The test results from the maintenance information system in the Powerhouse Department on diesel engine manufacturer can be seen in table I.
Table 1. Test results of powerhouse maintenance information system.

| No | User          | Test items                                      | The result is corresponding to the design (yes / no) |
|----|---------------|-------------------------------------------------|---------------------------------------------------|
| 1  | Admin         | Fill out the borrowing data for the tools       | Yes                                               |
|    |               | Fill out the return data for the tools          | Yes                                               |
|    |               | Fill out the order to repair the tools          | Yes                                               |
|    |               | Fill out the maintenance report for the machine | Yes                                               |
|    |               | Make a receipt and expense report for the tools | Yes                                               |
| 2  | Technician    | Fill out the borrowing data for the tools       | Yes                                               |
|    |               | Fill out the return data for the tools          | Yes                                               |
|    |               | Perform tools repair order                      | Yes                                               |
|    |               | Enter machine maintenance and repair results data| Yes                                               |
| 3  | Section Leader| Process maintenance and repair data              | Yes                                               |
|    |               | Manage vendor data                              | Yes                                               |
|    |               | Manage supplier’s data                          | Yes                                               |
| 4  | All           | Printing                                        | Yes                                               |

3.4. Transition stage

Transition stage consist of these parts:

3.4.1. Installation. Implementation of installation is easy because the maintenance information system for the powerhouse department is built on a PC based on Microsoft platform.

3.4.2. User training. Implementation training for admins, technicians, and section leaders lasts for 5 days each 2 hours. Training results show that they can operate each function easily. Their task outside of training is to enter data from a spreadsheet.

3.4.3. Evaluation. Observation of daily tasks for 2 weeks shows no significant difficulties and disturbances have been found.

4. Discussion

During building a maintenance information system for the Powerhouse Department, it requires thoroughness in obtaining data. When doing data retrieval requires accuracy because the data is still in the form of information without using database principles, the fields in the table are still in the form of 1NF. Careful observation is needed of the process of recording activities by technicians and service providers and the use of spare parts. Interviews were carried out on the technicians and the section leader.
of the maintenance division of the current repair were confirmed. Careful relational database design is needed, especially in determining the attributes of each table so that the separation of data from spreadsheets into normalized tables can be done easily. The process of designing a database table must be supported by query operations performed in front of the technicians and parts to obtain results from those whose query outputs do not match their needs.

Then a discussion of the initial design of the use case diagram was conducted to confirm the accuracy of the function and add functions that they did not know but later would be needed by them. After the use case diagram is agreed upon, we continue to design diagrams as can be seen in figure 3 to figure 13.

In the transition stage, the most time spent is when doing training, because it requires detailed discussion and explanation. Several improvements occurred in the query based on the results of the discussion during the training. The time for installation is relatively short, while the evaluation is carried out simultaneously with the time of death.

Result test of powerouse maintenance information system which includes 13 items in 4 sections all indicate that the output of the system is in accordance with the results of the discussion during all of the design phase. In general, the maintenance information system for the power generation department can be used correctly.

5. Closing
This system was successfully created and has been used as a tool for scheduling maintenance and repair of machine and tools in the Powerhouse Department in the diesel engine industry. The maintenance information system needs to be implemented in the company which includes maintenance or repair, and solving the problems that arise in order to avoid loss time that causes the production process to stop and leads to loss.

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