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IMPLEMENTATION OF HEAVY EQUIPMENT SERVICE MONITORING SYSTEM AT PT. SENTRA KARYA LOGISTIK

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Abstract

The service monitoring system is a monitoring process of the periodic service schedule for vehicle units or heavy equipment with the aim that no heavy equipment misses the periodic service schedule. Currently, the monitoring service system is widely used by large companies engaged in the logistics sector. PT. Sentra Karya Logistik is a company engaged in logistics and heavy equipment rent. PT. Sentra Karya Logistik has several problems in the process of monitoring heavy equipment services. These problems include checking the hours meter (HM) of heavy equipment which is still done manually by asking directly to each operator, recording and searching monitoring service data still using Microsoft Excel so that it takes a long time and there is no notification of heavy equipment that has entered service time so that many heavy equipment often miss their regular service schedule. Based on the above problems, a web-based heavy equipment monitoring service system was created using the waterfall method because this method uses a systematic and sequential approach. With system modeling using the Unified Modeling Language (UML). The purpose of this research is to create a system that can simplify the process of recording and searching monitoring service data and can provide notifications for each heavy equipment that is approaching its periodic service time. The result of this research is the Heavy Equipment Monitoring Service System at PT. Sentra Karya Logistik.

Keywords: Heavy Equipment, Monitoring Service, Monitoring Service System, Waterfall Method.

I. INTRODUCTION

PT. Sentra Karya Logistik is a company engaged in logistics and heavy equipment rental. PT. Sentra Karya Logistik is located at Jalan Raya Cilegon No. 39, Serdang Village, Kramatwatu District, Serang Regency, Banten Province. PT. Sentra Karya Logistik has several divisions, including human resources (HR) and general affairs (GA), marketing, operations, finance, and purchasing. The operations division is one of the fundamental functions of a logistics company. Operations are considered strategic within a logistics and heavy equipment rental company. The operations division plays a crucial role in the maintenance process and determines which vehicles or heavy equipment will be assigned to meet customer requests, as well as ensuring that the delivered heavy equipment is in good condition and ready for use.

PT. Sentra Karya Logistik faces several issues with its heavy equipment service monitoring process. These issues include manually checking the equipment's hour meter (HM) by directly contacting each operator; recording and retrieval of service monitoring data is still done using Microsoft Excel, which is time-consuming; and the lack of notification of equipment that is due for service, resulting in many equipment frequently missing scheduled service times. Considering the operational admin work is quite dense, the heavy equipment that must be monitored is quite a lot, and spread across several projects throughout Indonesia, the operational admin has difficulty in monitoring periodic service on each heavy equipment.

Monitoring or supervision is a series of processes that include information gathering, reviewing reports, and following up on data from ongoing processes [1]. Meanwhile, service (maintenance or repair) is a service activity that occurs through interactions between the service provider and recipient, with the support of facilities from an organization or company institution [2]. Every heavy equipment that is an asset at PT. Sentra Karya Logistik must receive monitored maintenance so that monitoring services are very necessary. Heavy equipment, commonly known in the engineering field, is a device used to facilitate human work in the construction of building structures and the like. The existence of heavy equipment is a crucial element in various projects, both small and large scale, especially in construction projects, mining, and other large-scale activities [3]. The service monitoring system is designed to solve problems that occur in service activities that are carried out periodically and continuously. The monitoring system is a collection of interconnected components that work in an integrated manner to carry out the monitoring function, with the aim of ensuring that each supervised process takes place in

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accordance with established procedures [4]. The issues focused on in this research include: ease of checking the hour meter (HM) of heavy equipment that is still awaiting the latest HM data from the operator; speeding up the recording and retrieval of periodic service monitoring data on heavy equipment, which currently uses Microsoft Excel and is time-consuming; and automatic notification for heavy equipment that is due for periodic service.

The method used in this research is the waterfall method. The waterfall model is known as a commonly applied software development method, where the process follows systematic and gradual stages [5]. The waterfall method was chosen because it has clear and structured stages, making it suitable for the system being built, as it has clear goals and needs.

The result of this research is an application that can display periodic service data such as the date and HM of the last service, the current HM, the next HM service, the remaining HM service and the service status. This application only requires timesheet data that is routinely provided by the operator to the operational admin. Where in the timesheet there is already the number of hours the equipment works each day that can be used as input data into this application, so that the operational admin no longer needs to check the HM on each equipment directly. This application will also send notifications via email and WhatsApp to the operational admin if there is an equipment that has entered its periodic service time. With this application, it can simplify the process of monitoring heavy equipment services so that no heavy equipment misses its service schedule and can work smoothly.

Research conducted by Sobri et al. shows that the vehicle condition monitoring information system built can improve the service provided by the travel agency to passengers and the existence of an information system that can monitor vehicle conditions online because it is stored in a database system that can be easily accessed at any time if needed [6]. According to Hanum et al., their research in designing a vehicle monitoring system using the PIECES analysis method, web-based with Unified Modeling Language (UML) modeling, succeeded in making the operational sales vehicle maintenance system at PT. Surya Mustika Nusantara more effective and efficient [7]. Research conducted by Barreta et al. in designing a printer service monitoring system makes it easy to monitor the progress of printer repairs by both customers and employees. This system also provides notifications via WhatsApp to customers to provide updates on the progress of their printer repairs [8]. Wu et al. conducted a study utilizing machine vision online monitoring system, successfully developing an online system to evaluate egg quality within caged environments. Their research plays a crucial role in enhancing production efficiency, streamlining farm management, and ensuring the welfare of the animals [9]. Research on the use of electric mobility is crucial for the future of transportation conducted by Sreenivasu et al. Detecting and predicting faults in electric motors improves EV reliability. This study highlights the potential of digital twins, ANNs, and ITS in estimating component lifespan and improving the energy efficiency of electric vehicles [10].

This study differs from previous studies in that it focuses on monitoring heavy equipment service by calculating hour meters (HM) and displaying service status. This study also improves on previous research by providing automatic notifications via WhatsApp and displaying the status of each piece of heavy equipment owned by PT. Sentra Karya Logistik.

II. METHODOLOGY

The development model used in this research method is the waterfall model. The waterfall method has 5 stages, as shown in Figure 1 below:

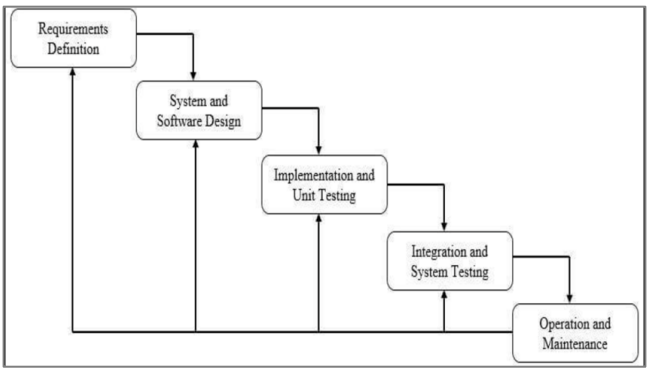

Figure 1. Waterfall Method Stages

Each stage of research using the waterfall method can be explained as follows:

1) *Requirement Definition*
   The definition of needs produces a complete description of what kind of software is needed and will be built [11]. At this stage, observations and interviews are conducted to find problems, system requirements and solutions to overcome existing problems in the running system. Observations carried out at PT. Sentra Karya Logistik include directly observing the heavy equipment service monitoring process to find existing problems. Interviews were also conducted with the Manager and Admin of the Operational Division to find out the service monitoring process flow of the running system. After conducting the interviews, information was obtained regarding the service monitoring flow of the running system and what was needed to design the system.
2) *System and Software Design*
   At this phase, the system design is developed using the data that has been gathered [12]. The results of the requirements analysis will be implemented into a design. The design is intended to provide a complete picture of what needs to be done. UML modeling is used to model the software to facilitate its implementation into the system. The database used in the design is MySQL.
3) *Implementation and Unit Testing*
   Next, we move on to the Implementation and Unit Testing phase. At this stage, the developed human factors engineering system is put into practice through training sessions and exercise programs [13]. This is the programming phase that implements the design into PHP source code. The system is divided into smaller modules that will be combined in the next phase. Furthermore, this phase also involves testing and checking the functionality of the modules to determine whether they meet the desired criteria.
4) *Integration and System Testing*
   After all units or modules have been developed and tested in the implementation phase, they are integrated into the

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overall system. After the integration process is complete, the entire system is inspected and tested to identify potential system failures and errors. Testing is conducted using the Black Box Testing method to identify potential system errors so they can be quickly fixed and ready for use. Black Box testing checks whether the software functions as expected by the user, without examining the program code and its internal structure [14]. Software testing is a crucial part of development as it ensures the functionality and quality of the software [15].

5) *Operation and Maintenance*
In the final stage of the Waterfall Method, the finished software is operated by users and maintained. Maintenance aims to correct errors not detected in the previous stages. Maintenance includes error correction, system unit implementation improvements, and system enhancements and adjustments as needed.

III. RESULT AND DISCUSSION

The result of this research is a heavy equipment service monitoring application that can be accessed by 4 different actors.

1. Usecase Diagram

This heavy equipment monitoring system involves four main actors: IT Admin, Operations Admin, Operations Manager, and Operator. Each actor has different access rights and functions according to their role and responsibilities within the system. The use case diagram in Figure 2 shows the menus accessible to each actor.

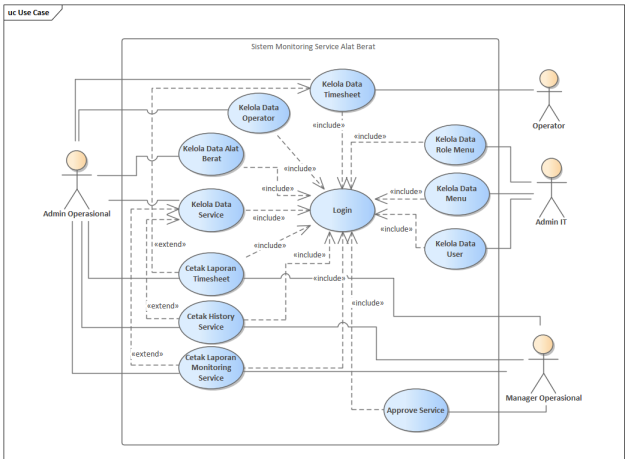

Figure 2. Usecase Diagram

1. IT Admin: The IT Admin plays a primary role in system management, both technically and through user access management. After logging in to validate their access rights as an IT Admin, this user can perform several important functions, including managing user data, managing menu data, and managing menu roles.
2. Operational Admin: The Operational Admin is responsible for managing operational data directly related to heavy equipment and operators. After logging in, the Operational Admin can manage operator data, heavy equipment data, timesheet data, and service data.
3. Operational Manager: The Operational Manager is responsible for validating and supervising heavy equipment operational activities.
4. Operator: The Operator is the system user who works directly in the field. After successfully logging in, the Operator can manage timesheet data, which involves inputting heavy equipment usage data each time it is used.

2. Application Design

a). Login Form
The following is a display of the login form for all users.

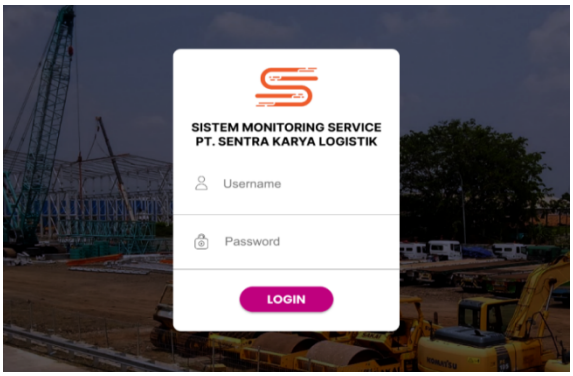

Figure 3. Login form

b). Dashboard
The following is a display of the service monitoring system dashboard after the user has successfully logged in.

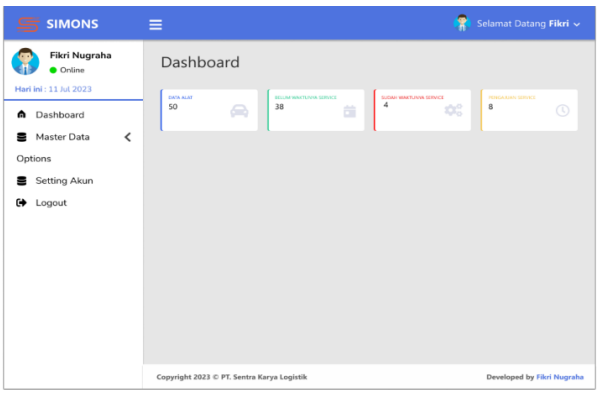

Figure 4. Dashboard for IT Admin

c). User Data Form
The following is a display of the user data page, which can only be accessed by IT admins. On this page, IT admins can add, change, activate, deactivate, and delete user data.

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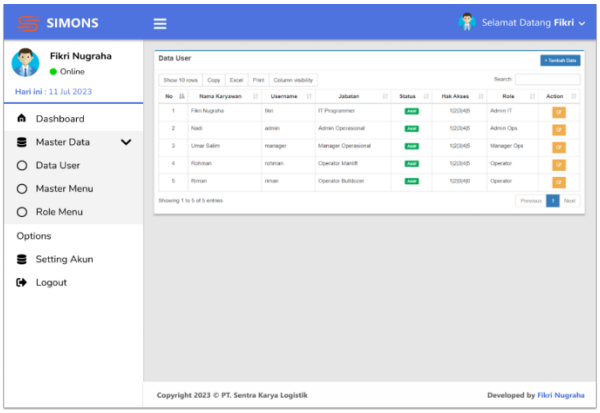

Figure 5. User Data Form

d). Master Menu Form

The following is a view of the master menu page, which is accessible only to IT admins. On this page, IT admins can add, modify, and delete menu items.

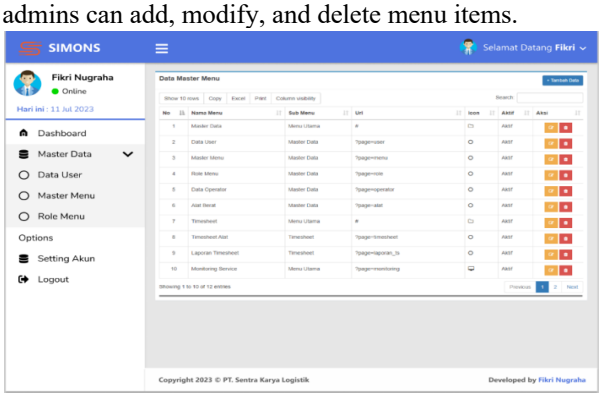

Figure 6. Master Menu Form

e). Role Menu Form

The following is a view of the role menu page, which is accessible only to IT admins. On this page, IT admins can modify each user's menu, such as adding or restricting the menus accessible to each role.

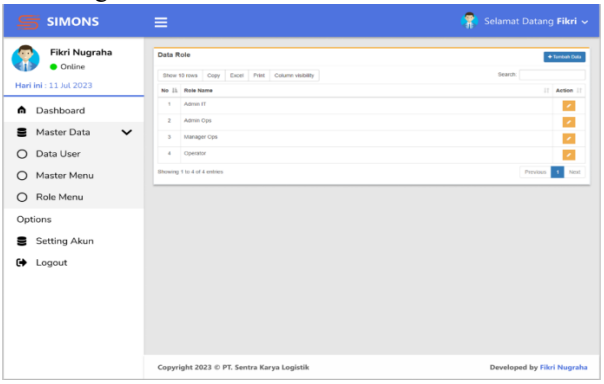

Figure 7. Role Menu Form

f). Operator Data Form

The following displays the operator data page, which is accessible only to operational administrators. On this page, operational administrators can add, change, delete, and deactivate operators.

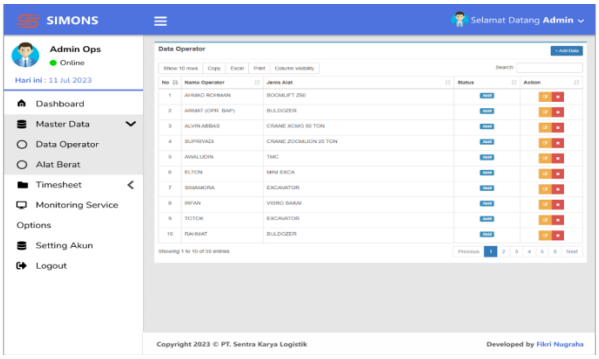

Figure 8. Operator Data Form

g). Heavy Equipment Data Form

The following displays the heavy equipment data page, which is accessible only to operational administrators. On this page, operational administrators can add, modify, and deactivate heavy equipment data.

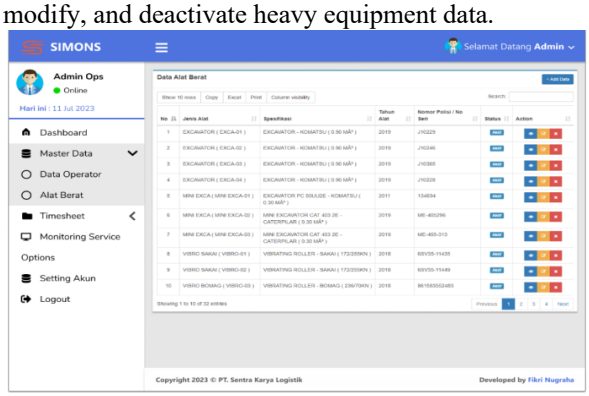

Figure 9. Heavy Equipment Data Form

h). Timesheet Form

The following is a view of the heavy equipment timesheet page, which is accessible only to operational administrators and equipment operators. Both operators and administrators can add timesheet data on this page. This page will display a list of heavy equipment timesheet data and there are buttons to add equipment, add timesheet and timesheet details.

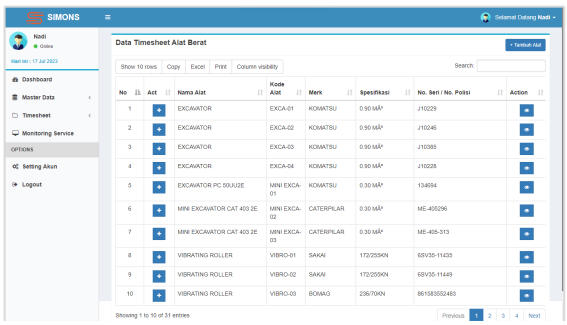

Figure 10. Timesheet Form

i). Add Service Submission Data Page

The following is a display of the service submission page which can only be accessed by operational

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admins.

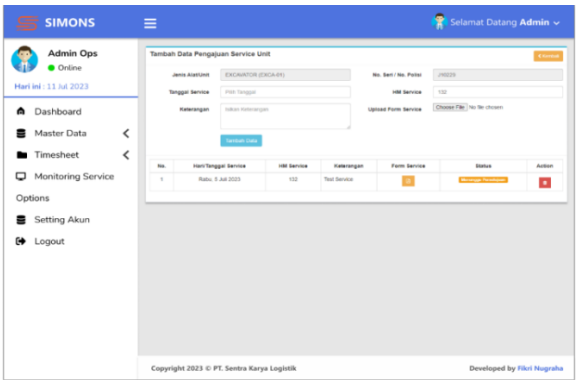

Figure 11. Add Service Submission Data Page

j). Timesheet Report Page View

On this timesheet report page, operational managers can print timesheet reports for operators and all equipment based on the desired date period. Reports can be downloaded as Excel files based on the operator criteria and date period entered.

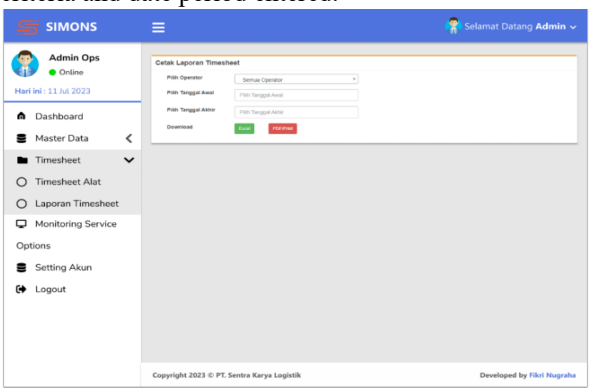

Figure 13. Timesheet Report Page View

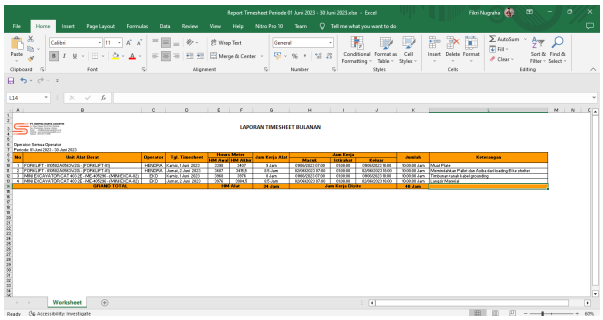

Figure 14. Monthly Timesheet Report Printout Results

k). Periodic Service Monitoring Data Page

The following is a display of the service monitoring page, which is accessible only to admins and operational managers. This page displays a list of periodic heavy equipment service monitoring data, as well as buttons for printing reports and service details.

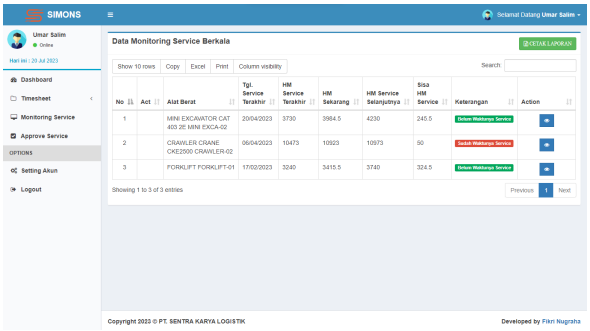

Figure 15. Periodic Service Monitoring Data Page

l). Page of the Service Monitoring Report

The following is a preview of the service monitoring report print page, which is accessible only to admins and operational managers. Clicking the print report button on the periodic service monitoring data page will download the heavy equipment periodic service monitoring report in Excel format.

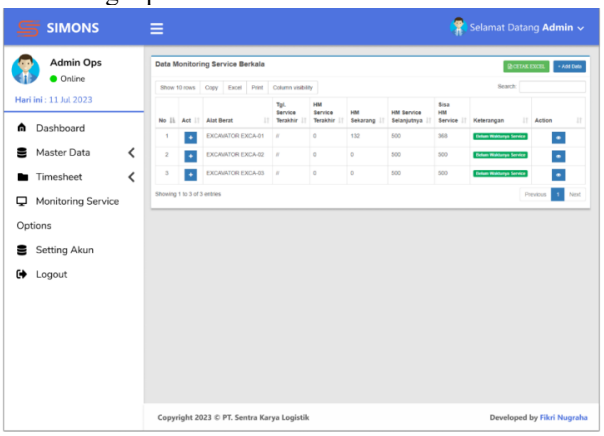

Figure 16. Page of the Service Monitoring Report

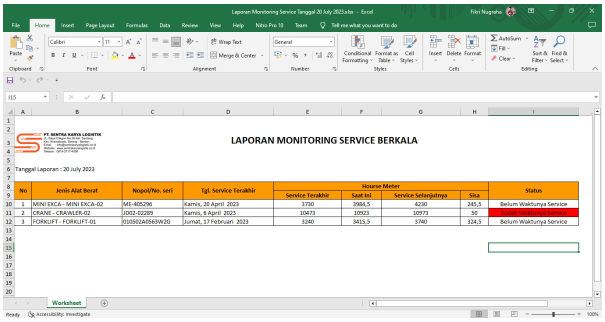

Figure 17. Monitoring Report Results Periodic Service

m). Detail Service Page

Select the heavy equipment user wants to see the service details for, then click on service details, then user will be taken to the service details page which displays all the service data for the selected equipment. Click the print service history button on the service details page to download the service history report document for the selected heavy equipment in the form of an Excel file.

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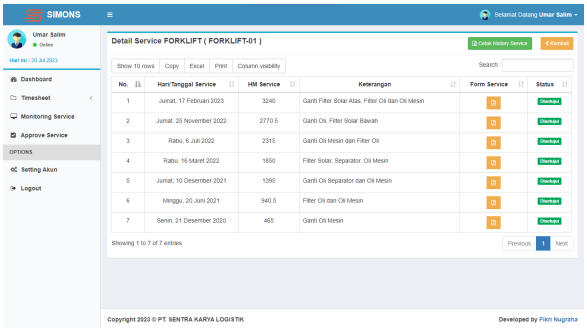

Figure 18. Detail Service Page

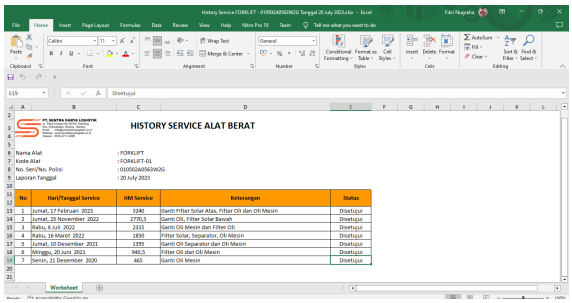

Figure 19. History Service Print Result

3. User Acceptance Test

The results of testing the main features of the heavy equipment service monitoring system at PT. Sentra Karya Logistik using the black box method are presented in the following table:

Table 1. User Acceptance Test

No.	Test Case	Description	Expected Result	Status
1	Login	Input correct username and correct password	User successfully logs into the main dashboard	Pass
2	Heavy equipment page	Add, edit, deactivated and search heavy equipment data	User able to add, edit, deactivated and search heavy equipment data	Pass
3	Heavy equipment timesheet page	Add, view detail, delete, and search Heavy equipment timesheet data	User able to add, view detail, delete, and search heavy equipment timesheet data	Pass
4	Timesheet report page	Select operator data and enter the date range of the report you want to print, then click print	Users able to download and print reports according to the date range data entered.	Pass
5	Monitoring service page	Add, print, view detail, search monitoring service data	User able to add, print, view detail, and search monitoring service data	Pass
6	Heavy equipment service application page	View documents, view detail and approval of Heavy equipment service application	User able to view documents, view detail and approval of Heavy equipment service application	Pass

IV. Conclusion

Based on the results of the research that has been conducted, it can be concluded that the web-based heavy equipment service monitoring system can speed up the process of checking the hours meter (HM) of heavy equipment at PT. Sentra Karya Logistik. Hour meter data will continue to be updated daily by each operator into the system. So that operational admins will be easier in checking the HM of heavy equipment. The service monitoring recording process is carried out through the system by inputting timesheet data containing the latest hours meter data for each heavy equipment by all operators so that the current HM and the remaining service HM in the service monitoring menu will be automatically updated in real time. The process of searching for heavy equipment service data can be done easily, namely by typing the name of the equipment/equipment code in the search section then clicking service details, then the service history of the selected heavy equipment will be displayed. The system can send notifications if there is heavy equipment that has entered its periodic service time via WhatsApp messages in real time. If the HM result is $\leqslant$ 50 then the system automatically sends a WhatsApp message to the operational admin, making it easy to find out which equipment has entered its periodic service time.

V. Suggestion

For further system development, it is hoped that this system can be integrated with the delivery note on each heavy equipment working at the project site, so that the timesheet can be filled in based on the delivery note, so that the working hours of the equipment and operators at each project location can be known based on the delivery note, and can be used as data for billing rent or payment of meal money to each operator. This system can also be developed for the process of monitoring vehicle documents, to find out the validity period of vehicle documents so that no one misses their tax payments.

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