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Development of a laravel-based web information system for network device maintenance management using the rapid application development method

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ABSTRACT

Information and Communication Technology (ICT) infrastructure is essential for government operations, particularly in managing network devices. Within the ICT Hardware Infrastructure Subdivision (Subbidang Harinfra TIK) of the Data and Information Center at the Indonesian Ministry of Defense, documentation of maintenance activities remains fragmented, making monitoring, analysis, and historical data storage less effective. This study developed a web-based information system using the Laravel framework and the Rapid Application Development (RAD) approach to address these issues. The system automates documentation, monitoring, and reporting, ensuring more structured, transparent, and efficient processes. Black Box testing confirmed reliable functionality, data validation, and improved efficiency in maintenance activities. Unlike previous studies that focused on general asset or helpdesk systems, this research emphasizes ICT infrastructure maintenance in a defense environment, highlighting security and adaptability for sensitive data. The implementation enhances systematic documentation and operational transparency, with future improvements directed toward intelligent notifications and platform integration in line with Industry 4.0 trends.

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1. INTRODUCTION

Information and Communication Technology (ICT) infrastructure is the operational backbone of organizations, including public sector entities, encompassing hardware, software, communication technologies, data, applications, and human resources responsible for their management (Ilmananda et al., 2022). It reinforces technological systems while supporting operational standards and technical competencies to ensure optimal service delivery. Maintenance is a critical component, aimed at sustaining equipment performance through periodic preventive measures such as functionality testing to preempt operational disruptions (Abror et al., 2023; Putra et al., 2024). Adequate understanding of work instructions and operational procedures enables personnel to conduct maintenance accurately and safely, reducing the risk of equipment failure (Asraf & Rasyidah, 2023).

The Data and Information Center of the Indonesian Ministry of Defense is mandated—under Minister of Defense Regulation No. 14 of 2019, Article 1256 to provide and maintain ICT infrastructure. Within Pusdatin, the ICT Hardware Infrastructure Subdivision (Subbidang Harinfra TIK) plays a crucial role in monitoring, assessing, and reporting on network devices. However,

observations and interviews with Prakom personnel in this subdivision revealed that maintenance and repair reporting remains fragmented and relies on unintegrated digital documentation. Such fragmentation creates inefficiencies in monitoring, data analysis, and archiving historical records, impedes report consolidation, and delays responsiveness to technical issues.

To address these challenges, this study proposes a web-based information system built with the Laravel framework. Laravel offers extensive packages and APIs for seamless application integration and developer collaboration, adopting the Model-View-Controller (MVC) architecture to separate business logic, user interface, and data management, resulting in a more structured and maintainable system (Alhari et al., 2022; Subecz, 2021). It also ensures stability and security for sensitive data handling, supported by libraries and packages that accelerate system integration and application development aplikasi (Firmansyah et al., 2022; B. R. Lubis & Muliani, 2024). Notable features include flexible routing, Eloquent ORM for database management, efficient migrations, and Artisan CLI, complemented by security mechanisms such as CSRF protection, input validation, and encryption (Al Zikri, 2021).

Previous studies confirm the role of information systems in enhancing operational efficiency across sectors. Apriliah et al. (2023) developed a Java-based maintenance service system, while Abror et al. (2023) implemented a web-based maintenance solution to overcome conventional reporting issues. Zakaria and Ardiansyah (2022) applied the RAD method to design a web-based helpdesk ticketing system, and Rahma and Utami (2024) created a website-based asset management system for structured documentation. Similar initiatives include PHP-MySQL-based village asset management (Irwan et al., 2024), web-based IT asset management (Sirait et al., 2024), and the Labarus application for state-owned asset monitoring (Ruhiyat & Nurfalah, 2025). Collectively, these findings underscore the significant contribution of digitalization to improving efficiency in data management, reporting, and asset maintenance.

This research advances these efforts by developing a Laravel-based information system specifically tailored to the ICT Hardware Infrastructure Subdivision of the Ministry of Defense's Data and Information Center, where high levels of data security and accountability are required. Academically, it contributes to the literature on ICT digitalization in government institutions by demonstrating how modern frameworks and development methods can be adapted for sensitive environments. Practically, the system provides more efficient, transparent, and secure documentation, monitoring, and reporting of network device maintenance, thereby supporting timely decision-making and strengthening the reliability of ICT infrastructure management.

2. RESEARCH METHOD

This study aims to design a web-based information system using the Laravel framework to support the recording, monitoring, and reporting of network device maintenance at Pusdatin Kemhan's ICT Infrastructure Division. The goal is to improve efficiency in ICT infrastructure management.

The Rapid Application Development (RAD) method is employed for its incremental and iterative approach, allowing users to provide direct feedback at each stage (Deni Murdiani & Muhamad Sobirin, 2022). RAD offers shorter development cycles, flexibility in adapting to changing needs, active user involvement, and recurrent user interactions (M. A. Lubis et al., 2024; Wang & Wang, 2022). An overview of the RAD methodology is presented in Figure 1.

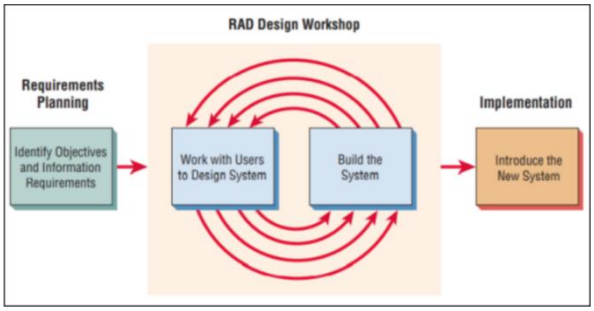

Figure 1. Model RAD Cycle (Triana et al., 2021)

a. Requirements Planning – System requirements were gathered through interviews with Prakom staff at the Hardware Infrastructure Subdivision (Subbidang Harinfra TIK) of the Data and Information Center at the Indonesian Ministry of Defense to address fragmented maintenance reporting. Functional specifications were defined and aligned with operational goals, producing a requirements specification document (Nurman Hidayat & Kusuma Hati, 2021; Triana et al., 2021). The system uses Windows 11, PHP 8.3.10, Laravel 8.x, and MySQL 5.7.43. Required hardware includes an Intel i7-1165G7, 8 GB RAM, and Intel Iris Graphics, ensuring high-performance development and testing
b. RAD Design Workshop – System architecture is modeled using UML diagrams, including Use Case and Activity Diagrams, ensuring optimal database structure and workflow. Laravel is chosen for efficient routing, middleware management, and database/API integration (Khairunnisa & Voutama, 2024). The MVC architecture supports modularity and maintainability.
c. Implementation – The design was implemented using Laravel and Blade Templating Engine (Sopiah et al., 2024) , with MySQL and Eloquent ORM for data handling (Ferddinansya et al., 2025). Key features include maintenance records, schedule notifications, and status reporting. The system is hosted locally for secure internal access. Black Box Testing verified functionality (Fahrezi et al., 2022) and validation was conducted with Kabid Infra TIK, Kasubbid Harinfra TIK, Kasubbid Renbang TIK, and Kasubbid Opsyan TIK.

3. RESULTS AND DISCUSSIONS

The developed system is described through an Activity Diagram and a Use Case Diagram. The Activity Diagram illustrates the workflow for recording and maintaining network devices, while the Use Case Diagram depicts user roles and access rights. This approach ensures that each process is well-documented and aligned with operational requirements.

Use Case Diagram

The Use Case Diagram for the network device maintenance and repair system at Pusdatin Kemhan illustrates the interactions between three main actors: Prakom, Kasubbid, and Admin. Prakom is responsible for logging in, carrying out maintenance and repair tasks, and preparing reports for review by Kasubbid. Kasubbid, in turn, logs in to provide guidance, review submitted reports, monitor devices, and archive the reports. Meanwhile, the Admin manages device data, user accounts, sub-division structures, and overall system workflows to ensure smooth operations. The collaboration among these three roles ensures that the maintenance and repair processes for network devices are more structured, thoroughly documented, and lead to improved efficiency and transparency in ICT infrastructure management at Pusdatin Kemhan. The Use Case Diagram depicting these interactions is presented in Figure 2.

Figure 2. Use Case Diagram

Activity Diagram

The following is the Activity Diagram for the network device maintenance and repair system at Pusdatin Kemhan, which visualizes the workflow and control processes within the system.
a. Manage Network Devices

Figure 3 illustrates the process of managing network device data within the system. The Admin accesses the device management module, and the system displays the list of available devices. The Admin can add, edit, or delete devices as needed. When adding or editing, the system presents a form to be completed, after which the Admin saves the changes. The system then provides a success notification and updates the data in the database. Once the device list is updated, the network device management process is completed.

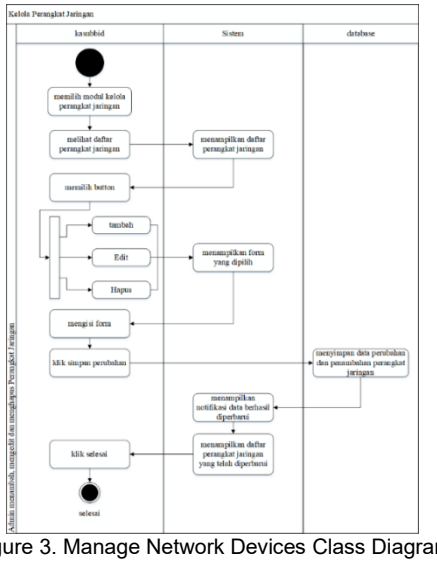

Figure 3. Manage Network Devices Class Diagram

b. Kasubbid Task Instructions

Figure 4 depicts the workflow of task instructions issued by the Kasubbid Harinfra TIK for network device maintenance. The Kasubbid assigns and monitors tasks carried out by Prakom. Upon receiving a task, Prakom conducts an assessment and updates the results in the system. The Kasubbid then reviews these results to either approve or request revisions. If approved, Prakom prepares the final report. If revisions are required, the task must be corrected in accordance with the Kasubbid's feedback. Once the report is accepted, the task is marked as completed in the system.

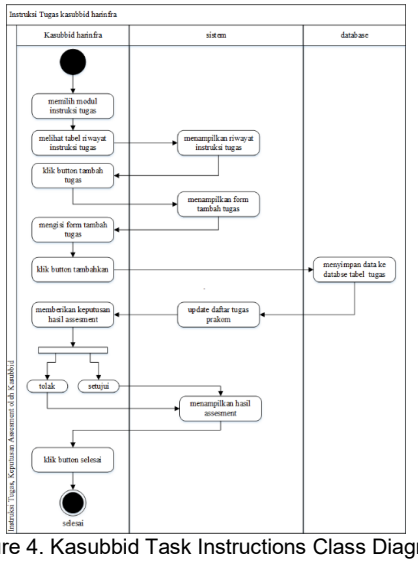

Figure 4. Kasubbid Task Instructions Class Diagram

c. Monitoring Reports

Figure 5 illustrates the workflow of the Kasubbid in managing Prakom's reports, starting from accessing the dashboard, reviewing the report history, and viewing report details when

necessary. This process ensures effective monitoring of reports and supports evaluation and decision-making.

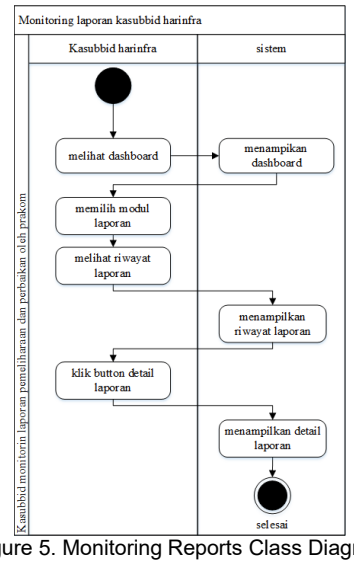

Figure 5. Monitoring Reports Class Diagram

d. Prakom assignments

Figure 6 presents the workflow for network device maintenance and repair carried out by Prakom. The process begins with accessing the task module and selecting assignments provided by the Kasubbid. Prakom then conducts an assessment of the device's condition and updates the results in the system for Kasubbid's review. If approved, Prakom prepares a report that is stored in the system, updates the device information, and is automatically recorded in the Kasubbid's report module. Finally, the system updates the task status and sends a notification to the Kasubbid as confirmation of task completion.

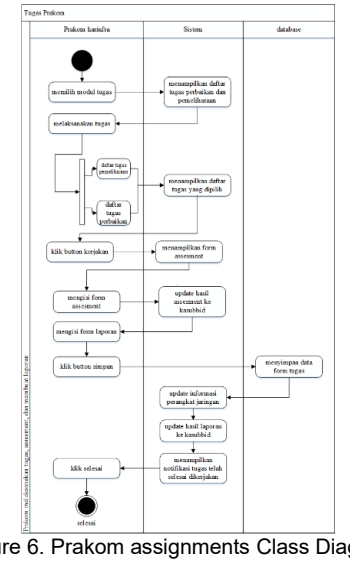

Figure 6. Prakom assignments Class Diagram

System Results

The result of this system development is a network device maintenance and repair application that supports the processes of task assignment, monitoring, and reporting in an integrated manner. The application interface is designed to facilitate the Kasubbid in assigning tasks, assist Prakom in carrying out tasks and preparing reports, and enable the Admin to manage network device data efficiently. This design ensures that every process is systematically documented and easily monitored, thereby improving the efficiency and accuracy of ICT infrastructure management.

a. Login Page

Figure 7 presents the login page, which allows Prakom, Kasubbid, and Admin to access the network device maintenance and repair system by entering a valid username and password according to their respective access levels.

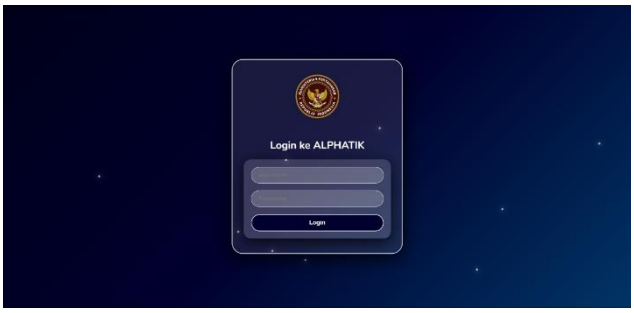

Figure 7. Login Page

b. Kasubbid Dashboard

Figure 8 illustrates the Kasubbid dashboard within the network device maintenance management system. The dashboard presents a summary of key information, including the number of Prakom staff, the total number of tasks, tasks in progress, tasks completed within the current month, as well as reports that have been accepted or rejected. In addition, it features charts that provide visual representations of task progress by Prakom and the devices that most frequently experience failures.

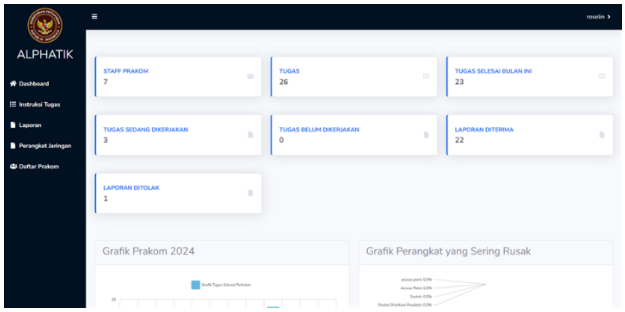

Figure 8. Kasubbid Dashboard

c. Network Device Management

The network device management page displays a list of hardware used in the system, including the Device Name, IP Address, Type, Location, and Condition. The table also includes the Date of Last Maintenance and Repair, and provides Detail, Edit, and Delete buttons for efficient management of network device data. The network device management page is shown in Figure 9.

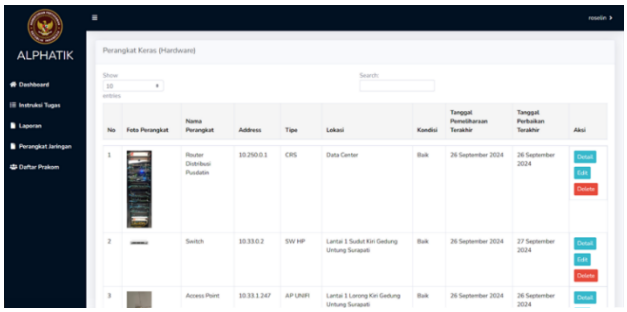

Figure 9. Network Device Management

d. Kasubbid Task Instructions

Figure 10 illustrates the task instruction workflow by the Kasubbid of ICT Infrastructure Maintenance in the maintenance of network devices. The Kasubbid can add and monitor tasks assigned to Prakom. Upon receiving a task, the Prakom conducts an assessment of the device and updates the results in the system. The Kasubbid then reviews these results to determine approval or the need for revisions. If approved, the Prakom prepares the final report; if rejected, the task must be revised according to the Kasubbid's notes. Once the report is accepted, the task is marked as completed in the system.

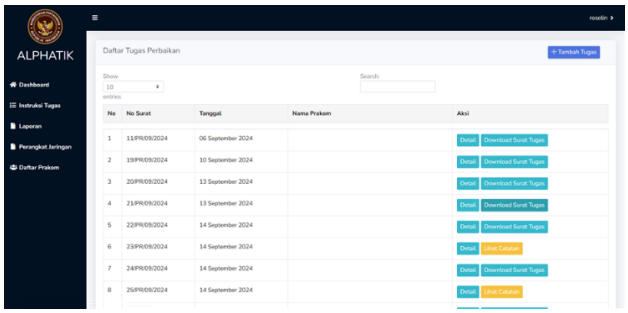

Figure 10. Kasubbid Task Instructions

e. Kasubbid Reports

Figure 11 displays a list of completed task reports, featuring a date range filter to show relevant data. Users can refresh the report view using the "Show" button and download the data in CSV or PDF format. The report table includes key information such as Task Letter Number, Task Letter Date, Start and End Dates, Type of Work (Maintenance or Repair), as well as a "Detail" button to view additional information.

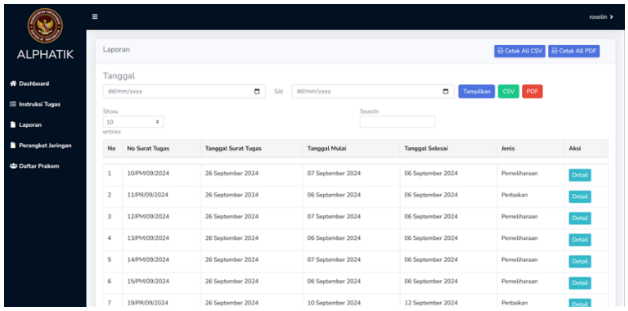

Figure 11. Kasubbid Reports

Blackbox Testing

System testing is conducted to assess the fully developed and integrated maintenance and repair system for network devices, ensuring it meets all defined requirements. This process does not involve analyzing the internal code structure but instead evaluates the system's overall performance. Based on Black Box testing, the system's functions work as intended, covering input validation, device information display, and the logging and updating of maintenance and repair activities. Furthermore, search and device management functions, including the Detail, Edit, and Delete buttons, operate smoothly without errors. The most recent maintenance and repair records are stored accurately and displayed consistently. These results confirm that the system can perform effectively to facilitate network device monitoring and management. The complete results of the Black Box testing are shown in Table 1.

Table 1. Black Box Testing

Page / Module	Test Scenario	Expected Result	Test Result	Remark
Login	User opens the application in a browser	Login page is displayed	Login page successfully displayed	Pass
Kasubbid Dashboard	Kasubbid views the total number of Prakom staff in Subbidang Harinfra TIK	Number of Prakom matches the user data in the system	Successfully displayed the correct number of Prakom	Pass
Kasubbid Dashboard	Kasubbid views the number of tasks by status (Completed, In Progress, Not Started)	Number of tasks matches their respective status categories	Successfully displayed the correct task counts by status	Pass
Kasubbid Dashboard	Kasubbid views the number of reports by status (Approved, Rejected)	Number of reports matches their respective status categories	Successfully displayed the correct report counts by status	Pass
Kasubbid Dashboard	Kasubbid views the task progress chart for Prakom	Task chart correctly displays Prakom's task data	Successfully displayed task chart for Prakom	Pass
Kasubbid Dashboard	Kasubbid views the device chart	Device chart displays frequently damaged devices	Successfully displayed chart of frequently damaged devices	Pass
Kasubbid Task Instructions	Kasubbid views task list containing task number, date, Prakom name, and action buttons (Detail, Download, View Notes)	Task list displays all information accurately	Successfully displayed complete and correct task list	Pass
Kasubbid Task Instructions	Kasubbid views task details by clicking the "Detail" button	Detailed task page displays complete information for the selected task	Successfully displayed task details with no errors or missing data	Pass
Kasubbid Task Instructions	Kasubbid downloads task letter by clicking the "Download Task Letter" button	Task letter is downloaded in correct format and opens without issue	Successfully downloaded and opened task letter in correct format	Pass
Kasubbid Task Instructions	Kasubbid views task notes by clicking the "View Notes" button	Task notes appear correctly and completely	Successfully displayed complete and correct task notes	Pass
Kasubbid Task Instructions	Kasubbid adds a new task instruction using the "Add Task" button	New task instruction is added and appears in the list with correct information	Successfully added and displayed new task with correct data	Pass
Kasubbid Reports	Kasubbid views report list containing report number, report date, Prakom name, and action buttons (Detail, Download, Status)	Report list displays all information accurately	Successfully displayed complete and correct report list	Pass
Kasubbid Reports	Kasubbid views report details by clicking the "Detail" button	Detailed report page displays complete information for the selected report	Successfully displayed report details with no errors or missing data	Pass
Kasubbid Reports	Kasubbid downloads report by clicking the "Download" button	Report is downloaded in correct format and opens without issue	Successfully downloaded and opened report in correct format	Pass

Analysis and evaluation

Compared to the fragmented conventional methods, this web-based system significantly improves time efficiency, data accuracy, and report transparency by integrating task assignment, monitoring, and reporting into a single platform. The system supports a structured maintenance workflow and facilitates stakeholder oversight, although it remains limited to the local network environment, interoperability with other Ministry of Defense systems, and lacks predictive or advanced security features. Future development could focus on intelligent notifications, predictive maintenance, deeper system integration, and enhanced data security, providing practical benefits for operations as well as academic contributions to the development of government ICT maintenance management systems.

4. CONCLUSION

The study developed a web-based application for the ICT Hardware Infrastructure Subdivision (Subbidang Harinfra TIK) at the Ministry of Defense's Data and Information Center to document and manage network device maintenance and repair activities. The system provides structured documentation, clear task assignments for Prakom, and improved task management, resulting in

more transparent and organized processes that support operational objectives. Practically, the application enhances maintenance efficiency, reduces reporting errors, and accelerates decision-making, while academically, it contributes as a case study on developing ICT device maintenance management systems in high-security government environments. Future improvements could include intelligent, context-aware notifications to improve responsiveness (Xu, 2025), integration with network device management and employee performance tracking systems to strengthen interoperability, and the adoption of Industry 4.0 technologies such as IoT, AI, and cloud platforms to reduce redundant data entry and minimize human error (Shaheen & Németh, 2022). Limitations of this study include reliance on a local network environment, limited integration with other systems, and absence of predictive maintenance features. Further research and development should focus on enhancing system security, interoperability, and predictive capabilities to make the application a more robust, efficient, and reliable tool for ICT infrastructure maintenance and repair management.

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