

Web-Based Facilities and Infrastructure Management Information System Using the Waterfall Method at Singosari Private Elementary School

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ABSTRACT

The management of facilities and infrastructure at Singosari Private Elementary School currently faces various challenges due to the manual nature of the process. This manual system causes several problems, including difficulties in accurately tracking the condition of assets, slow data retrieval, and the risk of data loss or corruption. To address these issues, this study aims to design and develop a computerized, web-based facility and infrastructure management information system. The system's development employs the Waterfall method, which includes the following stages: requirements analysis, system design, code implementation, testing, and maintenance. The system is designed to be easily accessible via a web browser, making it convenient for users to manage data from anywhere within the school environment. The result of this research is a functional, web-based information system application that can be implemented to manage facilities and infrastructure at Singosari Private Elementary School.

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1. INTRODUCTION

In today's digital era, educational institutions are required to adapt and integrate technology into every aspect of their operations in order to enhance efficiency, accountability, and quality of services. One of the vital components in delivering quality education is the management of facilities and infrastructure [1]. Facilities and infrastructure, which include school buildings, classrooms, libraries, laboratories, sports equipment, and furniture, are essential assets that support the smooth implementation of the teaching and learning process [1-4]. Effective and efficient management of these facilities and infrastructure will ensure that all of them are in good condition, properly inventoried, and optimally utilized to support the achievement of national education goals [5]. Proper asset control not only prolongs the lifecycle of school properties but also establishes a safe and productive environment for both students and educators [6].

However, in practice, many educational institutions, particularly at the elementary school level, still face complex administrative challenges in managing their facilities and infrastructure [2]. The management process is often still carried out conventionally through manual recording using physical inventory books or simple, non-integrated spreadsheet applications [7]. This manual approach has various systemic weaknesses, including high rates of human error during data entry, rapid physical deterioration of paper logs, and severe difficulties in tracking historical data changes [8, 9]. Such conventional, decentralized methods ultimately

hinder fast, data-driven, and accurate decision-making related to procurement, budgeting, and asset disposal [10].

Based on initial observations and interviews conducted at Singosari Private Elementary School, it was found that the daily management process of facilities and infrastructure still faces identical operational bottlenecks. Asset data recording, monitoring of current item conditions, and inventory report generation have not yet been integrated into a synchronized network. This structural fragmentation requires the administrative staff to expand extra time and physical effort just to compile basic data, which significantly increases the risk of data duplication and reporting inaccuracies. Furthermore, the absence of an automated logging system complicates accountability when assets are misplaced or broken.

Therefore, to thoroughly address these operational vulnerabilities, it is imperative to develop a computerized, web-based facility and infrastructure management information system [3]. Modern web applications offer cross-platform accessibility, allowing school administrators to access real-time data securely from any web browser within or outside the school perimeter [11]. In software engineering, the Waterfall model remains a highly reliable linear sequential framework for developing systems where operational demands and administrative rules are strictly defined from the outset [12]. By utilizing a structured database management system like MySQL paired with backend languages like PHP, web platforms can seamlessly centralize school records into a robust repository [13].

This system is expected to serve as an absolute technological solution to centralize asset data, facilitate the inventory control process, automate routine maintenance scheduling, and eliminate manual reporting delays [14]. By transforming these workflows, the integration of an information system reduces human intervention errors and ensures data longevity [15]. With the concrete implementation of this system, the overall management of facilities and infrastructure at Singosari Private Elementary School is expected to become more effective, efficient, transparent, and auditable, ultimately contributing to the long-term improvement of the quality of local educational services.

2. METHOD

This research methodology systematically outlines the specific steps taken to address the research problem. These stages include selecting the research site at Singosari Private Elementary School, determining the research subjects, and employing data collection techniques such as observation, interviews, and literature review. As for the system design and development process, this study uses the Waterfall method, which has a sequential and structured workflow ranging from requirements analysis, design, implementation, testing, to maintenance. This entire process is carried out to ensure that every step in this thesis is accountable and leads to the achievement of the predetermined research objectives.

2.1. Data Collection Methods

To obtain accurate and relevant data for the research, several data collection techniques were employed, namely observation, interviews, and literature study. Observation involved direct monitoring of the ongoing facility and infrastructure management process at Singosari Private Elementary School. The focus of observation included the workflow of asset recording, documents used such as inventory books, the physical condition of facilities and infrastructure, as well as identifying obstacles that arise in the manual process. Interviews were conducted through structured question-and-answer sessions with parties directly involved in facility and infrastructure management. The main respondents in this study were the Principal, to understand policies and managerial needs, and the Facilities and Infrastructure Officer, to gain detailed insights into daily operational workflows and challenges faced. Literature study involved collecting secondary data from various theoretical sources to strengthen the research foundation. These sources included books, scientific journals, articles, and previous theses relevant to information systems, asset management, the Waterfall system development method, and web-based technology.

2.2. System Development Methods

The development of this information system adopts a linear sequential model, often referred to as the Waterfall method. This method was chosen because it features a structured and systematic workflow, in which each phase must be fully completed and validated before moving on to the next phase [16]. This approach is particularly well-suited for projects with a scope that is clearly defined from the outset, as in this study.

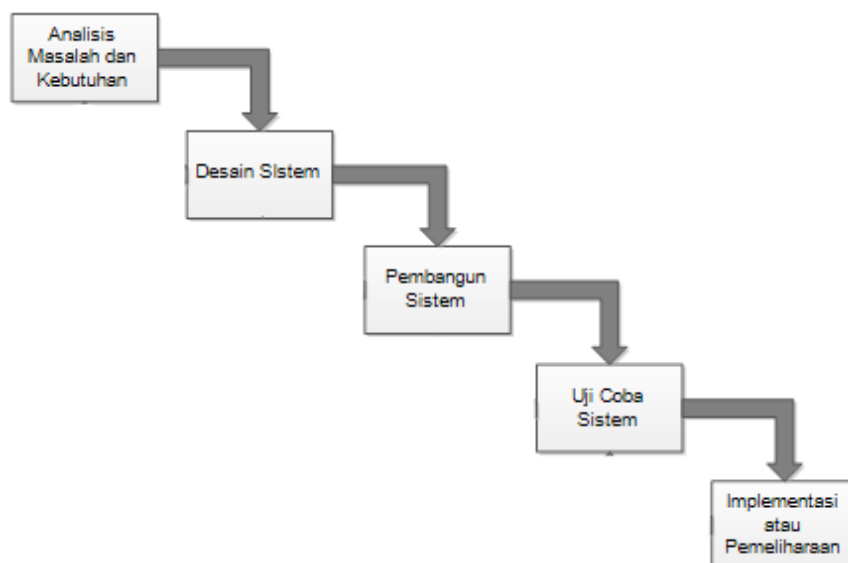


Figure 1. Waterfall Method

The implementation of each phase of the Waterfall method in the development of the Facilities and Infrastructure Management Information System at Singosari Private Elementary School began with a system requirements analysis, which involved conducting in-depth interviews with the principal to understand managerial needs and the types of reports required, as well as conducting interviews and direct observations with the facilities and infrastructure staff to understand current workflows (procedures), the documents used, and the operational challenges faced on a daily basis.

The second phase involves system and software design, which includes designing the overall system architecture and designing the database to determine which tables are needed (e.g., asset table, location table, user table) along with their relationships. This design is visualized using Class Diagrams; designing process flows and user interactions with the system using the Unified Modeling Language (UML), which includes Use Case Diagrams (to depict functionality and actors) and Activity Diagrams (to depict system workflows); and designing the user interface (User Interface), namely the visual layout of each page in the system, ranging from the login page and dashboard to data input forms and report views.

The third phase involves implementation and unit testing, which includes creating the database structure and tables in MySQL according to the Class Diagram design, coding to build the server-side (application logic) using the PHP programming language, building the client-side (interface) using HTML and CSS based on the UI design that has been created, and integrating the application logic (PHP) with the database (MySQL) and the interface (HTML/CSS) to form a cohesive, unified system.

The fourth phase involves system integration and testing using the Black Box Testing method, in which testing focuses on system functionality (input and output) without examining the internal code structure, performing a series of test scenarios, for example: attempting to log in with both correct and incorrect usernames, attempting to add new asset data, attempting to print reports, and ensuring the results match expectations, documenting all identified bugs or discrepancies for resolution in the subsequent phase.

The fifth phase involves system operation and maintenance, which includes installing software on the server and client computers at Singosari Private Elementary School, migrating data from the physical inventory ledger into the new system's database (if necessary), providing training to users (Facilities Staff and the School Principal) on how to operate the system, performing repairs if any bugs or errors are found after the system is in use, and making minor updates or adjustments to the system if future needs change.

3. RESULTS AND DISCUSSION

This discussion demonstrates that the developed system successfully addresses the existing issues at Singosari Private Elementary School. The manual system, which relied on physical ledgers, was highly prone to recording errors; the results of the new system's implementation show that it provides structured digital forms for data entry. A weakness of the old system was the risk of loss or damage to physical data; with the implementation of a MySQL database, all asset data is now stored digitally and centrally. Test results prove that data can be securely stored, modified, and deleted. By accelerating search and reporting processes, the

developed system has proven capable of displaying asset data instantly and, as demonstrated in the “Generate Report” function test, is able to automatically generate report documents.

Overall, the results indicate that the implementation of this web-based information system has successfully transformed the facility and infrastructure management process from a conventional and inefficient one into a modern, structured, and effective system. The system’s functional success, validated through Black Box Testing, confirms that the design outlined in Chapter III has effectively addressed all existing issues.

The following are some screenshots of the web pages for the facility and infrastructure management information system at Singosari Private Elementary School that has been developed.

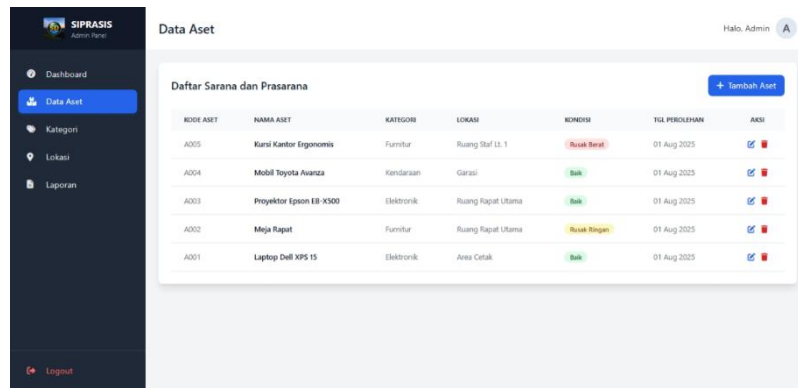


Figure 2. Asset Data Page

The Assets page is responsible for managing information about asset categories and displaying their visual representations.

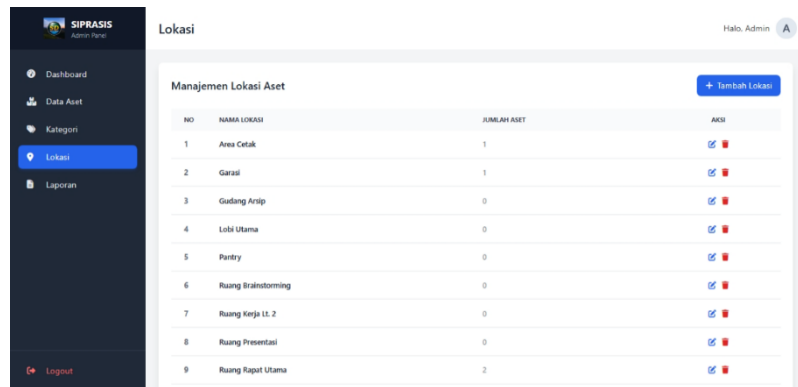


Figure 3. Asset Location Page

The asset location page displays the location of each asset at Singosari Private Elementary School.

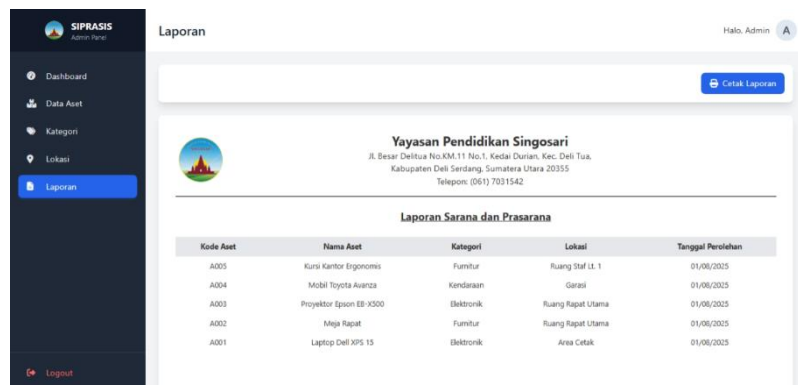


Figure 4. Report Page

The report page is a page that displays asset data categories, category data, or other summary information related to facilities and infrastructure at Singosari Private Elementary School.

4. CONCLUSION

Based on the discussion outlined in the previous sections, the essence of the Facilities and Infrastructure Information System at Singosari Private Elementary School can be summarized as follows:

1. The current facility and infrastructure management procedures at Singosari Private Elementary School are still carried out using conventional methods, involving manual record-keeping in inventory ledgers. This process has several significant drawbacks, including a high risk of human error, slow data retrieval, and inefficiency in report generation.
2. The design and development of a web-based information system were successfully carried out using the Waterfall development method. The system was designed with a user-friendly interface and a structured database to address the shortcomings of manual systems. The result is a functional application capable of digitizing the processes of asset recording, monitoring, and reporting.
3. The results of the system functionality testing using the Black Box Testing method indicate that all key features—from login and asset data management to report generation—are functioning correctly and in accordance with the expected requirements. Consequently, the developed system is deemed suitable for use and implementation, as it has proven capable of addressing the existing issues.

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