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Optimizing School Facilities and Infrastructure Data Collection Through Web-Based Digitization of the Master Asset Register

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ABSTRACT

School digitalization programs require the management of facilities and infrastructure to be accountable, efficient, and accurate. Currently, most schools still rely on manual, paper-based asset master logs, which are prone to recording errors, data loss, and reporting delays. This study aims to optimize asset data management by developing a web-based digital asset master log system. The research employs the Research and Development (R&D) method using the Waterfall model, encompassing stages such as requirements analysis, system design, implementation (using PHP, MySQL, and Bootstrap), black-box testing, and field trials at SMP Sepuluh Nopember Sidoarjo. The results demonstrate that the developed system improved data accuracy from 72% to 96%, reduced the average asset input time from 12 minutes to 3 minutes per item, and facilitated the generation of monthly reports within seconds. Feasibility assessments by media and subject matter experts yielded an average score of 4.6 out of 5 (highly feasible). Thus, the web-based digital asset master log proves effective in optimizing the management of school asset data.

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1. INTRODUCTION

Facilities and infrastructure are vital components in the delivery of quality education. Their completeness and condition directly impact the comfort, safety, and effectiveness of the teaching and learning process (Mulyasa, 2021). However, the availability of adequate facilities and infrastructure is insufficient without the support of a robust data management system.

Preliminary observations at several high schools in West Java revealed persistent issues regarding the management of electronic facilities and infrastructure systems (e-sarpras). The majority of schools still rely on manual record-keeping using physical ledgers. Consequently, data discrepancies frequently arise between the e-sarpras system, reports submitted to school committees, and room inventory records. Locating the history of specific items is difficult due to the lack of a rapid search function, and reports regarding damage or asset disposal are often delayed. Furthermore, the absence of data backups leaves information vulnerable to loss or deterioration over time. This situation persists despite the government—through the Ministry of Education, Culture, Research, and Technology—actively promoting digital transformation within educational institutions,

notably via the ARKAS platform. and Dapodik (Ministry of Education, Culture, Research, and Technology, 2022). Unfortunately, detailed record-keeping for facilities and infrastructure—such as the Master Asset Register has not yet been digitally integrated in most schools.

Several previous studies have developed web-based asset inventory systems, such as those conducted by Pratama et al. (2021) and Sari & Wijaya (2023). However, implementations at the school level rarely specifically address the Master Asset Register in accordance with national standard regulations. This is significant, given that the Master Asset Register serves as an official document for the accountability of state assets within the school environment.

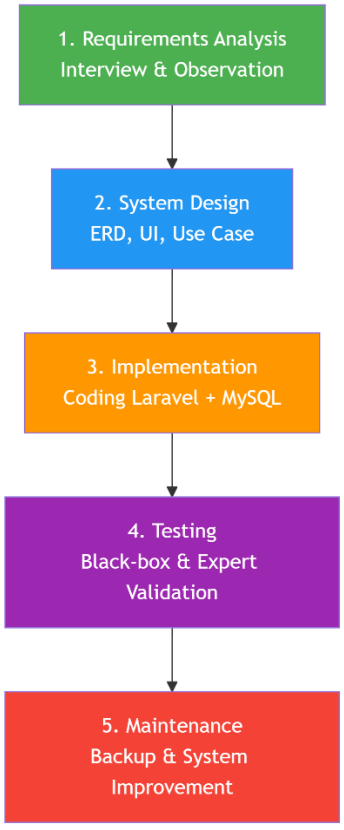
Addressing this gap, this study aims to develop and implement a web-based digital Master Asset Register system capable of optimizing the record-keeping of school facilities and infrastructure. The specific objectives are:

1. Increase the accuracy of facilities and infrastructure data to at least 90%.
2. Accelerate data entry and reporting processes.
3. Provide backup mechanisms and audit trails.
4. Facilitate the retrieval of asset history.

2. RESEARCH METHODOLOGY

2.1 Types of research

This study employs the Research and Development (R&D) method using the Waterfall model (Pressman, 2020), which consists of five stages: (1) Requirements engineering (requirements analysis), (2) System design, (3) Program code implementation, (4) Testing, and (5) Maintenance.



Picture 1 Waterfall Model for e-Sarpras System Development

2.2 Stage Descriptions:

The following is an explanation of the stages of the Waterfall method.

- Requirements Analysis: Interviews were conducted with the school principal and the facilities and infrastructure administrator, alongside direct observation of the manual BIB recording process. The outcome was a list of the system's functional and non-functional requirements.
- System Design: Designing the system architecture, including the Entity-Relationship Diagram (ERD), use case diagrams, and a prototype-based user interface design.
- Implementation: Coding the system using the Laravel 10 framework for the backend, MySQL for the database, and Bootstrap 5 for the user interface.
- Testing: Black-box testing was performed to ensure every function operated according to requirements, alongside feasibility testing by media and subject matter experts.
- Maintenance: Following system implementation, routine maintenance was carried out, including automated data backups, bug fixes, and the addition of features based on user needs.

2.3 Location and Time

The research was conducted at SMP Sepuluh Nopember during the odd semester of the 2025/2026 academic year, specifically from July to December 2025.

2.4 Research Subjects

The subjects of this study consist of several users, namely:
- 1 Deputy Principal for Facilities and Infrastructure
- 1 School facilities and infrastructure operator
- 25 Teachers

2.5 System Development Procedure

The development of this system requires several stages and activities. The following are the stages and activities involved.

Table 1. System Development Procedure

Stage	Activity
Needs analysis	Interviews with the school principal and facilities/infrastructure operator, review of manual facilities management documentation, and identification of required features.
System design	Creation of use case diagrams, activity diagrams, ERDs (Entity-Relationship Diagrams), and interface designs using Figma.
Implementation	Developed using the Laravel 10 framework, MySQL database, and Bootstrap 5, with deployment on the school's local server.
Testing	Black-box testing by developers and alpha testing by experts.
Field trial	System implementation was carried out over four weeks, followed by an evaluation using a questionnaire.

2.6 Research Instruments and Data Analysis

This study employs several instruments and data analysis methods; these are outlined below:
- Manual recording observation sheet (time and accuracy)
- Expert feasibility assessment questionnaire (Likert scale 1–5)
- User response questionnaire
- System logs to measure access speed

2.7 Quantitative data were analyzed using descriptive percentages:

This study utilizes quantitative data with descriptive percentages, as shown below:

$$\text{Feasibility Percentage} = \frac{\text{Score obtained}}{Score\ Maximal} + 100\% \qquad (1)$$

3. RESULTS AND DISCUSSION

In this research, we get results and discussions which are described by the results of system development, results of feasibility tests by experts, comparison of effectiveness, user responses, and discussion.

3.1. System Development Results

The system developed is named e-Sarpras School. The features included in this application are:

- Dashboard
- Item Data: Item Entry, Item Category, Item Location
- Report Data
- Users: Admin and User

3.2. Feasibility Test Results by the Deputy Head of Facilities and Infrastructure

The feasibility test results conducted by the Deputy Principal for Facilities and Infrastructure cover user-friendliness, feature clarity, compliance with application regulations, and data security, as well as the average total score obtained for each aspect.

Table 2. Feasibility Test Results by the Deputy Head of Facilities and Infrastructure

Aspect	Media Expert	Subject Matter Expert	Average
Ease of use	4,8	4,5	4,65
Clarity of features	4,6	4,7	4,65
Compliance with e-Sarpras regulations	4,2	4,9	4,55
Data security	4,5	4,4	4,45
Overall average	**4,53**	**4,63**	**4,58 (91,6%)**

3.3. Comparison of Effectiveness

The effectiveness comparison within this application covers data accuracy, input time per item, report generation time, and the rate of data loss.

Table 3. Comparison of Effectiveness

Indicator	Before (Manual)	After (e-sarpras)	Improvement
Data accuracy	72%	96%	+24%
Input time per item	12 minutes	3 minutes	-75%
Report generation time	2 days	5 seconds	very significant
Data loss rate	3x/year	never	-100%

3.4 User Response

Results from the 25 respondents show:

- 90% stated the system greatly assists with their work
- 80% reported learning to use the system in less than one hour
- 95% want the system to continue being used

3.5 Discussion

Research findings indicate that the digitalization of the web-based e-facilities and infrastructure system significantly optimizes data collection regarding these assets. The improvement in accuracy is primarily due to the elimination of handwriting errors and duplicate entries. The reduction in report access time—from days to mere seconds—has a substantial impact on the school principal's decision-making process.

4. CONCLUSIONS AND RECOMMENDATIONS

A. Based on the research results, it can be concluded that:

1. A web-based Master Asset Register digitization system was successfully developed using the Waterfall model.
2. Implementation of the school's e-facilities and infrastructure system significantly optimized asset data management: accuracy rose to 96%, data entry time decreased by 75%, real-time reporting was enabled, and data loss was eliminated.
3. The system's feasibility rating reached 91.6% (highly feasible).

B. Recommendations

1. For schools: Specialized equipment and regular training for operators are required.
2. For the education agency: Standardization of the e-facilities and infrastructure system across all supervised schools.
3. For future researchers: Include a module for scheduled asset maintenance and integration with Dapodik.

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