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Digital Transformation of Electronic Archive Management for Improving Business Operational Efficiency

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ABSTRACT

The rapid development of digital technology has encouraged organizations to transform conventional document management into electronic systems to improve efficiency, accessibility, and information management. In the Collection Division of PT Hakaru Metalindo Perkasa, archive management was still conducted manually, resulting in inefficiencies in archive recording, storage, retrieval, time, and maintenance costs. **This study** aims to develop a web based electronic archive management system to support more efficient and effective archive management and facilitate digital transformation in business operations. This study employed a **system development approach** using the prototyping method, consisting of communication, planning, modeling, construction, and delivery stages. Data were collected through interviews and observations to identify user requirements and existing archive management problems. The proposed system was developed using the CodeIgniter framework and supported by a database for structured archive management. System functionality was evaluated using black box testing. **The developed system provides** several functions, including archive data entry, classification, archive location management, archive circulation, user management, and archive data access. The black box testing results indicate that all tested functions operated successfully according to user requirements. **The web based electronic** archive management system can support the digital transformation of archive management by improving the efficiency, accessibility, and organization of archive related business operations.

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1. INTRODUCTION

Digital transformation has become an important strategy for organizations seeking to improve operational efficiency, information accessibility, and the effectiveness of business processes. The increasing volume of organizational documents requires companies to adopt digital technologies that can support systematic information management and reduce dependence on conventional processes [1]. Electronic archive management represents one practical form of digital transformation because it enables organizations to organize, store, retrieve, and circulate documents through integrated digital systems. From a business operations perspective, ef-

fective electronic archive management can reduce administrative workload, improve information accessibility, and support faster document retrieval [2]. This transformation is also aligned with Sustainable Development Goal (SDG) 9 industry, innovation and infrastructure, particularly the promotion of resilient infrastructure, technological innovation, and the adoption of digital technologies to strengthen organizational capabilities [3].

Despite the growing importance of digital transformation, archive management in some organizations remains dependent on manual procedures. The collection division of PT Hakaru Metalindo Perkasa, as examined in this study, previously managed archive information by recording document details manually in books and storing physical documents using filing cabinets, folders, and other conventional media [4]. This condition created several operational problems, including inefficient recording, limited storage space, difficulties in locating documents, and additional maintenance requirements. The existing process also reduced the effectiveness of archive circulation when documents were required by different divisions [5]. These conditions indicate the need for a digital archive management solution that can transform conventional archive activities into a more structured, accessible, and efficient business process [6]. Therefore, the implementation of a web based electronic archive management system is positioned as an approach to support digital transformation while improving the efficiency of business operations [7].

Based on these challenges, this study focuses on the development of a web based electronic archive management system designed to address the operational limitations of conventional archive management in the collection division of PT Hakaru Metalindo Perkasa [8]. The system was developed using the prototyping method, consisting of communication, planning, modeling, construction, and delivery stages, with interviews and observations used to identify system requirements [9]. The proposed system integrates archive classification, archive location, creator and processing unit information, archive media, user management, data entry, and archive circulation within a centralized web based environment [10]. System functionality was subsequently evaluated through black box testing to determine whether the developed features operated according to user requirements [11]. Through this approach, the study contributes to the digital transformation of business operations by demonstrating how electronic archive management can improve the organization, accessibility, and efficiency of document related processes while supporting technological innovation consistent with SDG 9.

2. LITERATURE REVIEW

2.1. Digital Transformation in Business Operations

Digital transformation refers to the utilization of digital technologies to transform conventional organizational processes into more integrated, efficient, and accessible digital processes [12]. It involves not only the implementation of technology but also changes in how organizations manage information and conduct operational activities. In business environments, digital transformation can reduce dependence on manual processes, improve information accessibility, and optimize the utilization of organizational resources [13].

Administrative activities are among the areas that can benefit from digital transformation because they involve continuous processes of recording, storing, processing, and retrieving information. Processes that rely on manual recording and physical documents may require considerable time, space, and operational resources [14]. Therefore, transforming conventional administrative activities into digital systems can provide organizations with a more systematic approach to managing information and supporting daily business operations [15].

2.2. Electronic Archive Management

Archive management is an essential organizational activity because archives function as sources of information and organizational memory. Effective archive management requires systematic processes for organizing, storing, securing, and retrieving documents [16]. Proper archive arrangement is important because poorly organized documents can make the retrieval process difficult and interfere with organizational activities. Therefore, consistent procedures are required to ensure that documents can be identified and retrieved efficiently when needed [17].

Electronic archive management applies information technology to the management of organizational records and documents. Electronic archives can support document classification, storage, retrieval, and circulation while reducing dependence on physical storage facilities [18]. In the collection division of PT Hakaru Metalindo Perkasa, archive management previously relied on manual recording and physical storage using filing cabinets, folders, and other storage media. This condition created problems related to data accuracy, storage space, document retrieval, and maintenance costs [19].

2.3. Information Systems for Electronic Archive Management

Information systems provide an important technological foundation for transforming conventional archive management into electronic archive management [20]. An electronic archive management information system can integrate archive data entry, classification, storage, retrieval, and circulation into a centralized digital environment. A web based system can also provide easier access to archive information and establish standardized archive data based on classification, creator, processing unit, location, and archive media [21].

The proposed system in the studied organization provides archive data input based on classification, creator, processing unit, archive location, and archive media type, as well as archive uploading and circulation functions [22]. The system was developed using the prototyping method, which consists of communication, planning, modeling, construction, and delivery stages. A database was also developed to manage archive data, classification codes, locations, media, creators, processing units, users, and archive circulation [23].

2.4. Electronic Archive Management and Business Operational Efficiency

Business operational efficiency refers to the ability of an organization to conduct activities effectively while utilizing available resources appropriately. In archive management, operational efficiency can be reflected through improved information accuracy, faster document retrieval, efficient use of storage space, and reduced resources required for archive maintenance [24]. Conventional archive management may create inefficiencies because manual recording can affect data accuracy, physical documents require storage space, poorly organized documents increase retrieval time, and physical archives require maintenance costs. These conditions were identified in the collection division of PT Hakaru Metalindo Perkasa [25].

The implementation of an electronic archive management information system provides an approach for addressing these operational problems. Digital archive data can be organized according to predetermined classifications and accessed through an integrated system, reducing dependence on physical storage and making information easier to manage [26]. The proposed system was evaluated using black box testing, with the results indicating that the system's input and output functionality operated successfully according to user requirements. The system was therefore designed to replace conventional archive management and support more efficient and effective operations [27].

2.5. Digital Transformation of Archive Management

The transformation of archive management from conventional to electronic processes involves changes in both technology and operational procedures [28]. Conventional archive management depends on physical documents, manual recording, and physical storage facilities, whereas electronic archive management transfers these activities into a digital environment where information can be recorded, classified, stored, and retrieved systematically [29]. This transformation can provide organizations with a more structured mechanism for managing documents while reducing the physical resources required for archive storage.

In the collection division of PT Hakaru Metalindo Perkasa, digital transformation is directed toward addressing problems related to efficiency, storage space, time, and cost [30]. The existing manual process requires physical storage, involves manual recording, makes document retrieval less efficient, and requires maintenance of physical archives [31]. Therefore, the implementation of an electronic archive management information system represents a transformation of an administrative business process from a physical and manual approach toward a digitally organized process that supports more efficient information management and business operations.

2.6. Research Gap

Previous discussions of electronic archive management have emphasized the importance of systematic archive organization and the utilization of information systems to support digital document management [32]. However, electronic archive management can be examined beyond the technical development of an information system by considering its role in the broader transformation of business operations [33]. The existing condition in the collection division of PT Hakaru Metalindo Perkasa demonstrates limitations associated with manual recording, physical storage, inefficient document retrieval, and archive maintenance.

Therefore, this study focuses on the digital transformation of electronic archive management as an approach to improving business operational efficiency. The research emphasizes not only the development of a web based archive system but also the transformation of archive management processes to address operational challenges related to efficiency, storage space, processing time, information accessibility, and maintenance

costs [34]. Through this approach, electronic archive management is positioned as part of the digital transformation of organizational operations and as a means of supporting more structured and efficient business processes.

3. RESEARCH METHOD

The research methodology was designed to systematically examine the existing archive management process and guide the development of a web based electronic archive management system for the collection division of PT Hakaru Metalindo Perkasa. The research procedures covered the research design, data collection, system development using the prototyping method, research framework, system modeling, and system evaluation. These procedures were conducted to identify operational problems, determine system requirements, develop the proposed system, and evaluate its functionality according to the identified user requirements.

3.1. Research Design

This study employed a descriptive qualitative approach to examine the existing archive management process and identify the operational problems encountered in the collection division of PT Hakaru Metalindo Perkasa. The research focused on the transformation of conventional archive management into an electronic archive management system to address problems related to archive recording, storage, retrieval, and management. The research was conducted based on the actual operational requirements of the organization [35].

The research followed a system development process using the prototyping method. This approach was selected because it allows system requirements to be identified through communication with users and refined during the development process [36]. The development stages consisted of communication, planning, modeling, construction, and delivery, which were used to guide the development of the proposed electronic archive management system.

3.2. Data Collection

Data were collected through interviews and direct observation. Interviews were conducted to obtain information regarding the problems experienced in archive management and the requirements of the users who would interact with the proposed system. Observation was used to examine the existing archive management activities and understand how archive information was recorded, stored, and retrieved within the organization [37]. The information obtained from the data collection process was used to identify system requirements and determine the functions required in the proposed electronic archive management system. The collected information subsequently became the basis for the communication and planning stages of the prototyping process.

The results of the interviews and observations were also used to identify the hardware and software requirements needed to support the development and operation of the proposed system [38]. The identified system requirements are presented in Table 1.

Table 1. System Requirements

No.	Source	System Requirements
1.	Hardware	One PC unit and printer
		8 GB total RAM
		Intel Celeron processor
2.	Software	Windows 10 operating system
		Web browser

Table 1 presents the hardware and software requirements identified for the development and operation of the web based electronic archive management system. The hardware requirements include a PC, printer, 8 GB RAM, and an Intel Celeron processor, while the software requirements consist of the Windows 10 operating system and a web browser. These requirements provide the basic technical resources needed to support the implementation of the proposed system.

3.3. Prototyping Method

The prototyping method was used as the system development approach in this study. The method consists of five stages including communication, planning, modeling, construction, and delivery. Communication was conducted to identify existing problems, planning was used to determine system specifications, modeling was conducted to design the proposed system, construction was used to develop the prototype, and delivery was conducted to obtain user feedback for evaluation [39].

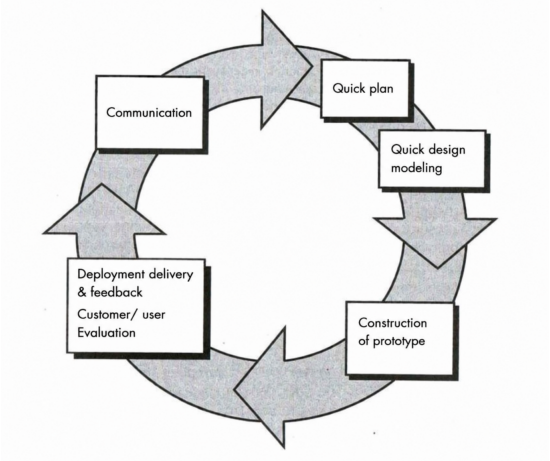

Figure 1. Prototyping Method

Figure 1 presents the sequence of the prototyping stages applied in this research. The process provides a structured development approach in which system requirements are identified and translated into a prototype that can subsequently be evaluated based on user feedback.

3.4. Research Framework

The research framework was used to organize the overall research process and establish the relationship between problem identification, system requirements, system development, and evaluation [40]. The framework provided guidance for conducting the research systematically from the identification of problems in the existing archive management process to the development of the proposed electronic archive management system.

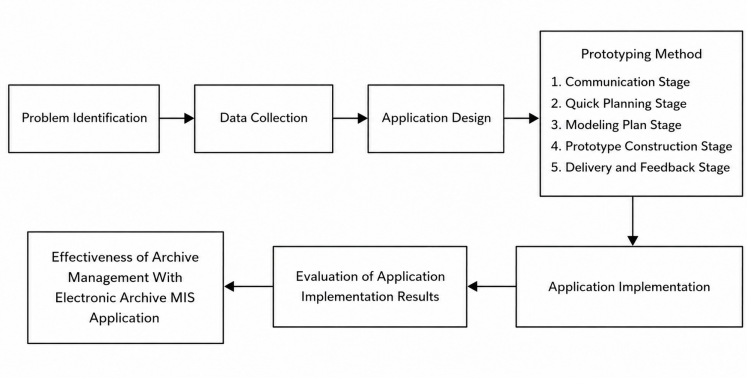

Figure 2. Research Framework

Figure 2 depicts the research framework used to guide the systematic development and evaluation of the proposed electronic archive management system. The process begins with the communication stage, which is used to identify the existing archive management problems and gather the requirements of the users who will interact with the proposed system. The identified requirements are then translated into a quick plan and quick design modeling to determine the initial system structure and workflow. Based on the design, a

prototype is constructed to represent the proposed electronic archive management system and provide an initial version that can be reviewed by users [41]. The prototype is subsequently delivered to users for evaluation and feedback, allowing the identified requirements and system design to be reviewed and refined when necessary. This iterative process enables the system to be developed progressively according to the operational needs of the organization and ensures that the final system is aligned with the requirements identified during the research process.

3.5. System Modeling Approach

Following the identification of system requirements, system modeling was conducted to translate the requirements into a structured system design. The modeling process included the development of use case and activity diagrams to describe system functions and user interactions [42]. A system workflow was also developed to represent the sequence of activities performed by users when interacting with the proposed system. The resulting system models were subsequently used as references for the construction of the prototype. The system modeling stage therefore served as a transition between the identification of user requirements and the implementation of the electronic archive management system.

3.6. System Evaluation

The developed system was evaluated using black box testing to examine whether the implemented functions operated according to the specified requirements. The testing focused on the functionality of the system, particularly its input and output processes [43]. User evaluation was also incorporated into the prototyping process to obtain feedback regarding the suitability of the developed system. The testing and evaluation procedures were used to determine whether the proposed electronic archive management system could function as intended. The detailed results of the system implementation and testing are presented and discussed in the results and discussion section rather than in the research method [44].

4. RESULT AND DISCUSSION

4.1. Existing Archive Management Analysis

The analysis of the existing archive management process identified several operational problems in the collection division of PT Hakaru Metalindo Perkasa. Archive details were still recorded manually in books, which reduced the accuracy and efficiency of archive management. Physical documents also required considerable storage space for filing cabinets, folders, and other storage media. In addition, document retrieval was considered ineffective because the archive arrangement was not sufficiently organized, while physical archive storage required maintenance and associated costs.

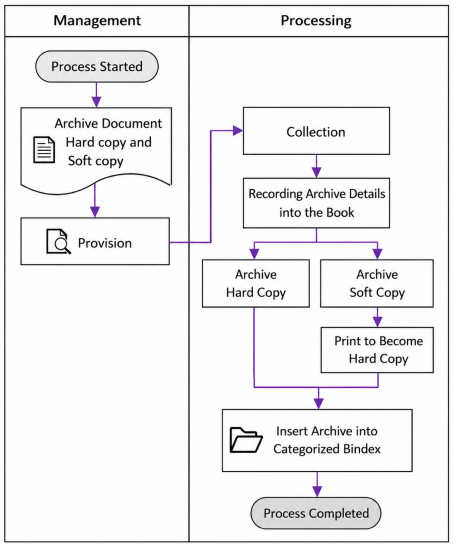

Figure 3. Existing Archive Management Process

Figure 3 shows the conventional archive management process before the implementation of the proposed system. The process relies on manual recording and physical document storage, where archive information is recorded in books and documents are stored using filing cabinets, folders, and other physical storage media. This approach creates several limitations, particularly in terms of information accuracy, storage capacity, document retrieval time, and archive maintenance. The manual recording process may increase the possibility of errors in archive information, while dependence on physical storage requires considerable space and makes documents more difficult to locate when needed. In addition, maintaining physical archives requires additional time and resources, which can affect the efficiency of daily business operation. These conditions demonstrate that the existing archive management process was not sufficiently efficient to support operational requirements and became the basis for developing a more structured digital archive management solution.

4.2. Proposed Archive Management Process

Based on the problems identified in the existing process, a new archive management process was proposed to replace the conventional approach. The proposed process was designed according to the identified operational requirements and aimed to provide a more structured mechanism for recording, organizing, storing, and accessing archive information through a web based electronic archive management system. The new process integrates these activities into a centralized digital environment, enabling archive information to be managed more systematically and reducing the limitations associated with manual recording and physical document storage. In addition, the proposed process was designed to support easier retrieval and circulation of archive information, thereby improving the efficiency and accessibility of archive management activities within the organization.

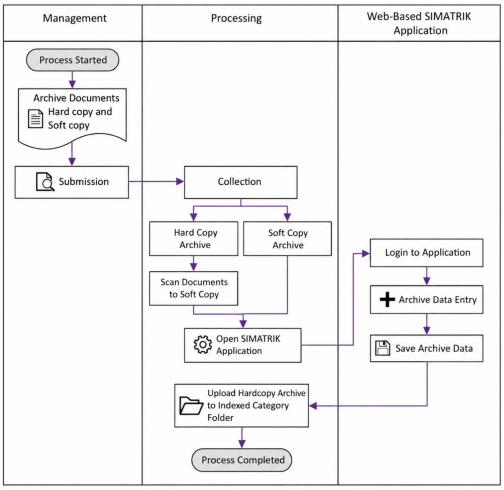

Figure 4. Proposed Archive Management Process

Figure 4 describes the proposed archive management process after the transformation into a web based electronic archive management system. The proposed process changes archive management from a manual and physically dependent procedure into a structured digital workflow, where archive information can be managed through integrated system functions, allowing the organization to record, organize, store, and access records more systematically. The proposed process addresses the limitations identified in the existing system by reducing dependence on manual recording and physical archive storage while providing a more structured environment for managing archive information and supporting easier access to records. Therefore, the proposed process represents a digital transformation of archive management activities by improving the way archive information is recorded, organized, stored, and accessed rather than merely changing the medium used to store documents.

4.3. System Modeling Results

The system modeling stage produced models that represent the functions, user interactions, and operational flow of the proposed electronic archive management system. A use case diagram was developed to

describe the interaction between users and the system, including the main functions that can be accessed and performed during archive management. In addition, a system workflow was developed to illustrate the sequence of activities carried out by users when recording, managing, and accessing archive information within the system. These models were developed based on the requirements identified during the earlier stages of the research and served as a reference for ensuring that the proposed system functions corresponded to the operational needs of the organization. The modeling results also provided a structured basis for translating the identified requirements into system functions and workflows before the system was implemented.

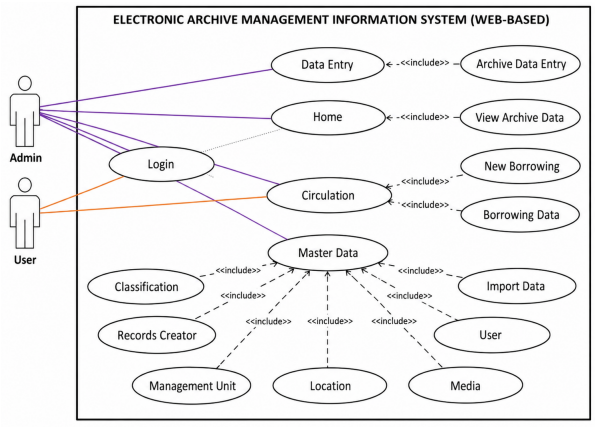

Figure 5. Use Case Diagram

Figure 5 demonstrates the interaction between users and the functions available in the electronic archive management system. The use case diagram provides a structured representation of the system functions and shows how users interact with the proposed system through the available features. It identifies the main activities that can be performed within the system and provides an overview of the relationship between users and the functions required for archive management. The diagram was developed based on the system requirements identified during the earlier stages of the research, ensuring that the available functions correspond to the operational needs of archive management. Therefore, the use case model provides a functional reference for the implementation of the proposed electronic archive management system.

To further describe the operational sequence of the proposed system, a system workflow was developed to illustrate the activities performed by users when managing archive information. The workflow represents the process from the initial interaction with the system through the execution and completion of archive management activities. It provides a clearer view of how users move between system functions and how archive information is processed throughout the workflow. This model complements the use case diagram by focusing on the sequence and flow of activities rather than only the interaction between users and system functions. The resulting system workflow is presented in Figure 6.

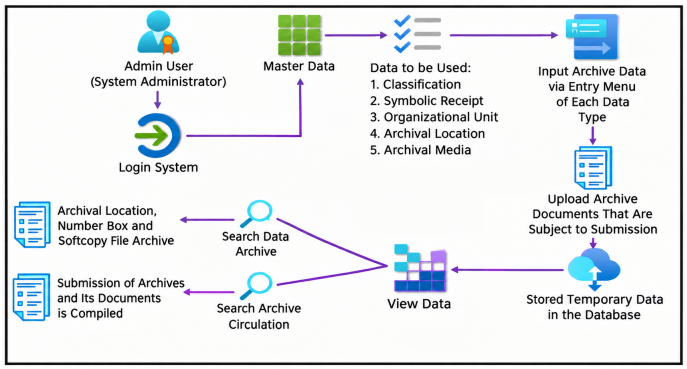

Figure 6. System Workflow

Figure 6 visualizes the workflow of the proposed electronic archive management system. The workflow provides a structured sequence for managing archive information and clarifies how users perform archive related activities within the system, from the initial interaction through the completion of archive management processes. Compared with the conventional process, the modeled workflow provides a more systematic digital procedure for handling archive information by organizing each activity within the proposed system. The workflow also demonstrates how the system functions are connected to support the recording, management, and access of archive information. Therefore, the modeling results provide a clear connection between the identified operational problems and the implementation of the proposed system, with the use case and workflow models establishing the functional and procedural basis for developing the web based electronic archive management system [45].

4.4. Electronic Archive Management System Implementation

The proposed system was implemented as a web based electronic archive management information system using the codeIgniter framework, with bootstrap CSS and JavaScript Query (jQuery) supporting the interface development. The system provides several functions, including login, archive data entry and import, archive classification, archive location and media management, archive creator and processing unit management, user management, and archive circulation. A supporting database was also developed to organize archive data, classification codes, locations, media, creators, processing units, users, and circulation records systematically.

The implementation integrates these archive management activities within a single digital environment, allowing users to manage archive information through structured system functions rather than relying on manual recording and physical documents. The developed interfaces, including the login, home, archive data entry, circulation, classification, creator, processing unit, and archive location pages, provide practical support for transforming the conventional archive management process into an organized electronic process.

4.5. System Testing and Operational Efficiency Discussion

The developed system was evaluated using black box testing to determine whether its functions operated according to the specified requirements. The testing focused on the input and output functionality, with the results indicating that the tested functions operated successfully and were consistent with user requirements. From an operational perspective, the system addresses the main limitations of the conventional process by replacing manual recording with digital data entry, reducing dependence on physical storage, organizing archive information through predefined functions, and supporting document circulation between divisions.

The implementation can therefore improve archive management across four operational dimensions: efficiency, space, time, and cost. Digital recording and structured archive data support more efficient information management and retrieval, while electronic storage reduces the need for physical storage and its associated maintenance resources. Overall, the findings indicate that the web based electronic archive management system can serve as an alternative to the conventional process by transforming how archive information is recorded, organized, accessed, and circulated within business operations.

5. MANAGERIAL IMPLICATION

The findings of this study indicate that the conventional archive management process in the collection division of PT Hakaru Metalindo Perkasa is inefficient in terms of accuracy, storage space, retrieval time, and maintenance costs. The implementation of a web based electronic archive management information system provides a practical managerial solution by replacing manual recording and physical storage with structured digital management. The system enables administrators to manage archives based on classification, creator, processing unit, archive location, and media type, as well as perform archive circulation. The black box testing results also show that the system functions properly and meets user requirements.

From a managerial perspective, the findings suggest that organizations should consider digital transformation in records management by establishing standardized archive classifications, user access rights, and systematic archive circulation procedures. The centralized database can support better control and retrieval of organizational information while reducing dependence on physical storage. The prototyping approach also provides managerial value because system requirements can be identified, modeled, tested, and refined through user feedback before implementation.

For future research, the system could be evaluated over a longer implementation period by measuring its impact on archive retrieval time, operational costs, storage requirements, data accuracy, and user satisfaction. Future studies could also examine the integration of automated backup, stronger access control, digital signatures, document search, and cloud based storage. These developments would provide further evidence regarding the long term effectiveness and scalability of electronic archive management systems.

6. CONCLUSION

This study concludes that archive management in the collection division of PT Hakaru Metalindo Perkasa requires improvement because the existing conventional process still relies on manual recording and physical document storage. This condition creates problems related to accuracy, storage space, retrieval time, and maintenance costs. The findings show that the conventional process is less efficient because archive information is recorded manually, physical storage requires considerable space, and poorly organized documents make the retrieval process less effective. Therefore, a web based electronic archive management information system was designed as a solution to improve the effectiveness and efficiency of archive management.

The developed system provides several functions that support systematic archive management, including archive data entry, classification, archive location, archive media, archive creator, processing unit, user management, and archive circulation. The system was developed using the prototyping method, consisting of communication, planning, modeling, construction, and delivery stages, allowing the system to be developed according to user requirements. The evaluation results show that the components developed during the modeling stage were in accordance with user expectations. In addition, the database was designed to support organized archive storage, while the web based interface facilitates users in managing and accessing archive information.

Overall, the findings demonstrate that the proposed web based electronic archive management information system can serve as an effective alternative to the existing manual system. The black box testing results indicate that the system functionality, both input and output, operates properly and meets user requirements. The system can facilitate archive storage, classification, retrieval, and circulation while reducing dependence on physical documents and manual procedures. Therefore, the implementation of this system is expected to support more efficient and effective archive management within the company and improve the availability of organizational information when it is needed.

7. DECLARATIONS

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7.2. Author Contributions

Conceptualization: SJ; Methodology: DY; Software: AF; Validation: AN and TM; Formal Analysis: SJ and DY; Investigation: AF; Resources: AN; Data Curation: TM; Writing Original Draft Preparation: SJ and DY; Writing Review and Editing: AF and AN; Visualization: TM; All authors, SJ, AN, DY, TM and AF have read and agreed to the published version of the manuscript.

7.3. Data Availability Statement

In line with our commitment to research transparency, the dataset underlying this study has been archived in the Zenodo Repository https://doi.org/10.5281/zenodo.22052935.

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7.5. Declaration of Conflicting Interest

The authors declare that they have no conflicts of interest, known competing financial interests, or personal relationships that could have influenced the work reported in this paper.

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