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Design and Development of SIMPENDA: A Web-Based Pension and Personnel Information System for Kudus Regency Agriculture and Food Office

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Abstract. *This study aims to design and develop a web-based Pension Information and Personnel Data System (SIMPENDA) as a digital solution for managing employee data and pension administration processes at the Kudus Regency Agriculture and Food Service. The system was developed using the Waterfall method, which consists of the stages of needs analysis, system design, implementation, testing, and maintenance. The results show that SIMPENDA is able to integrate all personnel and pension processes into one efficient and secure digital platform. This system provides convenience in managing employee data, calculating pensions, and tracking pension administration status in real time. Based on functional tests and user acceptance tests (UAT), all system features functioned well and obtained an average user satisfaction score of 4.65 out of 5, indicating excellent user acceptance. This system has been proven to improve administrative efficiency, data accuracy, and transparency of the pension process. In addition, SIMPENDA also supports the implementation of the Electronic-Based Government System (SPBE), in accordance with government policy to encourage the digitalization of public services. These findings not only benefit the Kudus Regency Agriculture and Food Service, but can also be used as a model for personnel digitalization in other regional government agencies, which is expected to improve the overall quality of public services.*

Keywords: *E-Government, Pension, Personnel Information System, SIMPENDA, Waterfall*

1. INTRODUCTION

In the era of digital transformation and the Fourth Industrial Revolution, local governments in Indonesia are required to improve the quality of public services through the implementation of electronic-based governance systems (e-government). The Presidential Regulation of the Republic of Indonesia No. 95 of 2018 on the Electronic-Based Government System (SPBE) emphasizes that all government agencies must begin to transition from manual administrative processes to digital systems in order to achieve efficiency, transparency, and accountability (Presiden RI, 2018). Within this context, one of the most essential components of modern governance is the management of civil service data and the administration of civil servant retirement processes.

The management of personnel data, commonly known as the Civil Service Information System (SIMPEG), in many Indonesian government institutions is still carried out manually or semi-automatically using spreadsheets or fragmented systems that are not integrated. This condition has led to several operational issues, such as data duplication, delays in updating records, data loss, input errors, and difficulties in generating reports or formulating personnel policies (Rohaimudin & Aulia, 2025). Moreover, the retirement process for civil servants

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(PNS) often involves multiple administrative stages and cross-verifications among various agencies—such as the Regional Civil Service Agency (BKD), financial administrators, and payroll offices—which can significantly lengthen the overall processing time (U.S. Office of Personnel Management, 2025). On a global scale, many countries have adopted digital pension management systems (e-pension) to improve the efficiency and transparency of public service administration (PolicyBazaar, 2024).

In Indonesia, several studies have explored the implementation of web-based personnel information systems in educational institutions, local governments, and private organizations. For instance, research conducted at Universitas Muhammadiyah Metro found that manual personnel data management hindered the preparation of personnel reports due to the absence of digital records of employment decrees (SK). The introduction of a web-based information system significantly improved the efficiency, accuracy, and transparency of personnel data management. Similarly, studies in regional civil service and education offices demonstrated that web-based systems facilitate real-time data updating and ensure easier access to personnel records (Putri et al., 2023; Neliti, 2022). Another study on PT Indo Prima highlighted the benefits of web-based systems in managing employee attendance, payroll, and data storage, showing their ability to streamline administrative processes and improve decision-making efficiency (Jurnal JTSI, 2023).

However, most of these studies focused primarily on general personnel management modules such as attendance, leave, and payroll systems, without specifically addressing retirement management. The retirement module is often developed as a separate application or still handled manually by personnel departments. The lack of integration between personnel and retirement management systems limits an organization’s ability to track pension contributions, project retirement benefits, and verify pension submissions automatically. This separation not only reduces efficiency but also increases the potential for administrative errors and data redundancy.

In the context of the Department of Agriculture and Food in Kudus Regency, the need for an integrated system that combines personnel management and pension administration has become increasingly urgent. As a regional government institution with hundreds of civil servants and functional staff members, the department faces the challenge of managing a growing number of employees approaching retirement age. When most of the retirement administrative processes are still conducted using physical documents or unconnected digital files, inefficiencies, data inconsistencies, and delays in service delivery are almost inevitable.

These problems can negatively impact both institutional performance and employee satisfaction.

To address these challenges, this study aims to design and develop SIMPENDA (Pension and Personnel Data Information System), a web-based integrated information system that unifies personnel data management and pension processing within a single digital platform. Through this system, the agency can manage various personnel-related data—including demographic information, job position, leave, transfer, and compensation—while simultaneously administering pension applications, document verification, and retirement reporting automatically. The implementation of such a system is expected to support digital transformation within local government institutions, increase operational efficiency, and improve transparency in human resource management.

The contributions of this research are twofold. Theoretically, it proposes a model architecture for an integrated personnel and pension management system that can be adopted by other regional government agencies, thereby enriching the literature on e-government, information systems (IS), and public digital service design. Practically, it provides a concrete digitalization solution for the Department of Agriculture and Food in Kudus Regency to enhance the accuracy, efficiency, and transparency of personnel and pension administration, potentially serving as a reference model for other local government institutions across Indonesia.

To build a strong conceptual foundation, this research adopts several relevant theories and models. The DeLone and McLean Information System Success Model (2003, updated 2016) is used to assess system success through dimensions such as system quality, information quality, user satisfaction, and net benefits. The Technology Acceptance Model (TAM) and its extended version, the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003), explain user adoption behavior toward new information systems. Additionally, the e-Government Maturity Model—which outlines five stages of digital government development—is applied to evaluate the organization's digital transformation level. For system development methodology, this study refers to the Waterfall, Prototype, and Agile Development approaches, as they provide structured and iterative frameworks suitable for government-based system design (Suwandi & Wahyu, 2023; Persada Khatulistiwa Journal, 2021).

Several key challenges are anticipated during the development and implementation of SIMPENDA. The first is data security and confidentiality, since personnel and pension data are highly sensitive and require robust authentication, encryption, and access control

mechanisms (Putra & Kartika, 2021). The second is system interoperability, as the system may need to integrate with payroll systems, regional financial systems, or the national civil service database (BKN), demanding standard data exchange protocols. The third is user adoption, as resistance to technological change among government employees remains a major barrier; hence, training, user-friendly interfaces, and effective change management communication are necessary. Finally, system testing and empirical evaluation—including user acceptance testing, system performance measurement, and user satisfaction surveys—are essential to validate the effectiveness and usability of the developed system.

In conclusion, this study does not merely aim to produce a technical application but seeks to provide a comprehensive reference for the development of digital governance systems within regional institutions. By integrating personnel and pension management through SIMPENDA, the Department of Agriculture and Food in Kudus Regency can accelerate its transition toward a more efficient, transparent, and accountable digital administration system, aligned with Indonesia's national e-government agenda.

2. THEORETICAL REVIEW

An information system is a set of interrelated components designed to collect, process, store, and disseminate information to support decision-making and organizational control (Laudon & Laudon, 2022). In the public sector, information systems function as key tools to enhance administrative efficiency, transparency, and accountability (Heeks, 2020). The personnel information system (SIMPEG) serves as an essential subsystem responsible for managing employee data, promotions, transfers, and retirement records of civil servants (O'Brien & Marakas, 2021).

According to Hussein et al. (2020), the implementation of information systems in government should not be viewed merely as the automation of paperwork but as a transformation toward smart governance. Therefore, system development in local government institutions should consider user needs, data integration across agencies, and information security.

E-government refers to the use of information and communication technologies (ICTs) to improve public service delivery, citizen participation, and governance effectiveness (United Nations, 2022). Heeks (2020) emphasizes that e-government enhances administrative efficiency through process automation, cost reduction, and greater accessibility. In Indonesia, Presidential Regulation No. 95 of 2018 mandates that all government institutions implement electronic-based governance systems.

The e-government maturity model explains the evolution of digital government from the stages of presence, interaction, transaction, integration, to digital governance (Andersen & Henriksen, 2006). SIMPENDA aligns with the integration stage, where multiple administrative modules—particularly personnel and pension management—are connected in one comprehensive system to improve the quality of internal services.

The DeLone and McLean Information System Success Model (2003; 2016 update) is one of the most widely adopted theoretical frameworks to evaluate system effectiveness. It comprises six dimensions: system quality, information quality, service quality, use, user satisfaction, and net benefits. These dimensions collectively explain how information systems deliver both functional and organizational value. In this study, the model is applied to evaluate how SIMPENDA improves administrative efficiency, enhances data accuracy, and contributes to organizational performance within the Department of Agriculture and Food of Kudus Regency.

User acceptance is a crucial determinant of information system success. The Technology Acceptance Model (TAM) by Davis (1989) posits that user adoption is influenced by perceived usefulness and perceived ease of use. The Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003) extends TAM by incorporating performance expectancy, effort expectancy, social influence, and facilitating conditions. These models are relevant in the SIMPENDA context to understand behavioral intentions of employees and administrators in adopting the system and to guide the design of user-friendly interfaces that encourage regular use.

The Waterfall model is a traditional software development approach that follows sequential stages: requirements analysis, system design, implementation, testing, and maintenance (Pressman & Maxim, 2020). It is particularly suitable for projects with well-defined requirements and structured organizational environments, such as government institutions (Sommerville, 2020). This research adopts the Waterfall model because the personnel administrative workflow in the Department of Agriculture and Food is already standardized, allowing each development stage to be conducted systematically. This approach facilitates better documentation, validation, and evaluation of the SIMPENDA system.

Conceptually, this study integrates the Information System Success Model and TAM/UTAUT to explain the determinants of successful system implementation and user acceptance, while e-government theory provides the policy and governance framework. The Waterfall methodology serves as the technical foundation for system design and development. The integration of these theoretical perspectives forms the conceptual framework underpinning

the design, implementation, and evaluation of SIMPENDA as a sustainable, web-based information system for civil service and pension management in local government.

3. RESEARCH METHODOLOGY

Data collection was carried out to obtain accurate and comprehensive information regarding the system requirements and the existing business processes within the Department of Agriculture and Food of Kudus Regency. This study employed both primary and secondary data sources to ensure the validity and reliability of the findings.

Primary data were obtained through direct observation and structured interviews with employees from the personnel division. The observation process aimed to identify workflow patterns, administrative constraints, and document management procedures involved in the pension application process. Meanwhile, interviews were conducted to explore in-depth the functional requirements of the system from both user perspectives—namely, civil servants as system users and administrators as system managers. This stage provided practical insights into user needs and operational pain points, forming the foundation for designing a user-centered system.

Secondary data were collected through a literature review of relevant scholarly sources, including academic journals, textbooks, and previous studies related to personnel information systems, web-based pension application systems, and software development methodologies. The review process helped the researchers formulate an appropriate conceptual approach, select the most suitable system development model, and align the SIMPENDA design with best practices in e-government system design and implementation.

The system development process was conducted using the Waterfall methodology, a classical model in software engineering that emphasizes a systematic and sequential flow of development stages. This method was selected because the system requirements and expected functionalities had been clearly defined from the outset, making a structured and linear approach the most appropriate for this project. The Waterfall model also provides clear documentation and traceability, which are essential in government-based projects where accountability and procedural compliance are required (Pressman & Maxim, 2020; Sommerville, 2020).

The implementation of the Waterfall model in this study included the following stages:

At this stage, a detailed identification and analysis of system requirements were conducted based on the data collected during the observation and interview phases. The analysis focused on mapping the workflow of personnel data management, the pension

submission process, and the specific information or features needed by both system users and administrators. The output of this stage was a Software Requirements Specification (SRS) document, which served as the foundation for system design.

This stage involved designing the system architecture and user interface (UI/UX) to ensure usability and functionality. Technical designs such as flowcharts, data flow diagrams (DFD), and relational database models were developed to describe data interactions and logical processes within the system. The database schema was constructed to ensure consistency, scalability, and data security. The system design phase also included the development of mockups and prototypes for early-stage usability evaluation.

In the implementation phase, the system was developed using PHP as the backend programming language and MySQL as the database management system. The integrated development environment (IDE) used was Visual Studio Code, which supports efficient coding and debugging processes. The web interface was designed using HTML, CSS, and JavaScript frameworks to ensure responsiveness and accessibility. The coding process followed modular development principles to facilitate maintenance and future system scalability.

After system implementation, testing was conducted to verify that all modules functioned according to the defined requirements. Several types of testing were performed, including functional testing, input validation testing, login security testing, and integration testing among modules. The testing phase adopted a black-box testing approach, focusing on whether system functions produced the expected outputs for specific inputs. Any identified errors or bugs were fixed through a structured debugging process. The testing results ensured that the system met the performance, reliability, and usability standards required for deployment in a government environment.

The final phase involved system evaluation and maintenance based on the feedback gathered from trial use by administrative staff and civil servants. This phase aimed to refine the system's performance, improve interface usability, and fix potential technical issues discovered during user testing. Maintenance also included updating features, optimizing system performance, and ensuring data security compliance in line with local government digital service standards.

Through these stages, the SIMPENDA system was developed systematically to meet user needs effectively, enhance the efficiency of personnel and pension administration, and contribute to the broader initiative of digital transformation within local government agencies.

This study employed a Research and Development (R&D) approach to design, develop, and evaluate the SIMPENDA system prototype. The research followed an iterative process,

combining system engineering principles with empirical data collection to ensure that the final system addressed real institutional needs. The combination of qualitative methods (observation and interviews) and technical system design allowed for both functional and user-oriented validation of the developed system.

Digitizes and centralizes employee and pension data, reducing administrative redundancy. Enables real-time tracking of pension applications and verification status. Provides structured documentation and reporting capabilities for decision-making. Increases transparency, data accuracy, and user satisfaction.

By implementing this methodology, the SIMPENDA system is expected to serve as a replicable model for other regional government offices seeking to modernize their human resource and pension management processes through web-based information systems.

4. RESULTS AND DISCUSSION

The web-based Pension and Personnel Data Information System (SIMPENDA) was successfully developed through five stages of the Waterfall methodology. The system integrates two core modules: personnel management (employee profiles, job positions, ranks, education, employment status) and retirement management (submission, verification, document upload, approval, and reporting). SIMPENDA operates under a dual-access structure: Administrator and Employee. Administrators handle verification, data validation, and reporting, while employees can submit retirement applications, upload documents, and monitor the status of their applications online.

The flowchart illustrates the logical process of SIMPENDA, outlining the interaction between users (admin and employees) and the system. It depicts all major activities—login, personnel data management, retirement submission, verification, and report generation. This visualization enables the developers to understand process dependencies and ensures the correctness of the workflow.

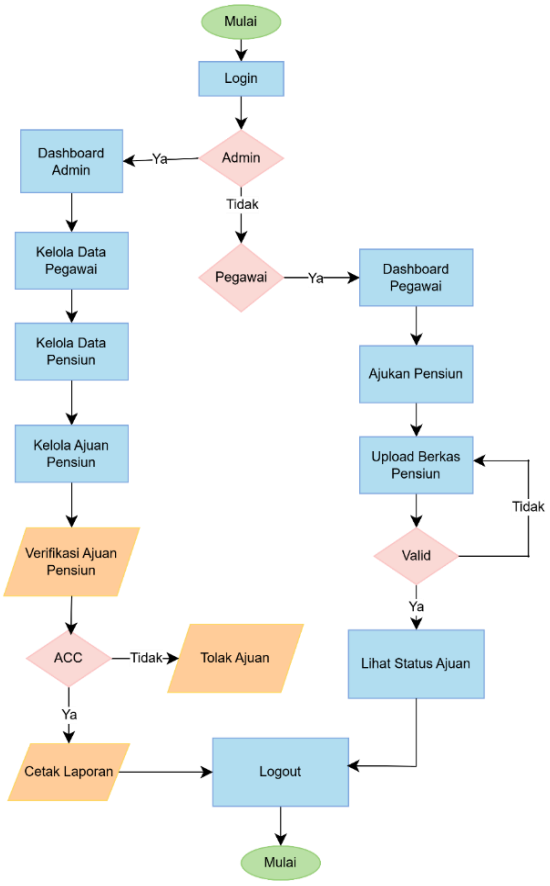

Figure 1. Flowchart SIMPENDA**.**

The Level-0 DFD provides a high-level overview of data movement across three major processes: managing employee data, managing retirement data, and handling retirement submissions. Two external entities—Admin and Employee—interact with the system, supported by two main data stores (employee and pension databases). This model clarifies data input-output relationships and highlights the need for robust data security mechanisms.

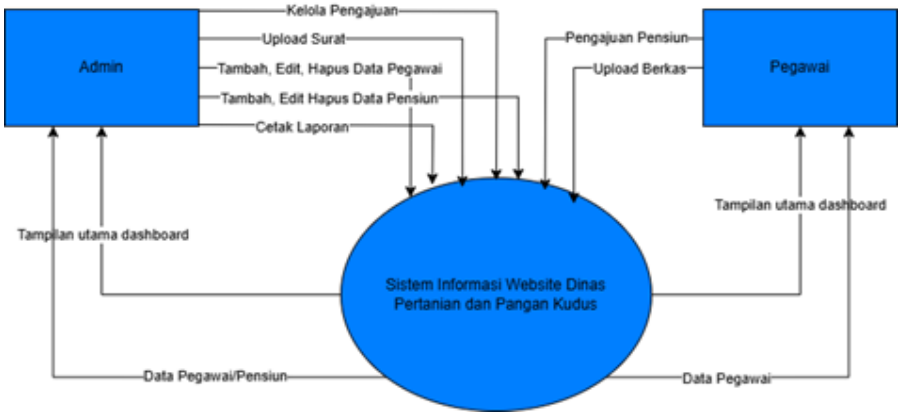

Figure 2. Level 0 DFD**.**

Functional Testing Results

Table 1. Functional Testing of SIMPENDA (Black-Box Method).

No	System Feature	Testing Objective	Result	Status
1	Login & Authentication	Ensure only valid users can access the system	Successful	✓ Pass
2	Employee Registration	Validate new account creation	Data stored and verified by admin	✓ Pass
3	Employee Data Management	CRUD operations on employee records	Works as expected	✓ Pass
4	Pension Data Management	Record and update retirement data	Data linked correctly	✓ Pass
5	Online Pension Submission	Allow employees to submit requests	Submissions appear in admin dashboard	✓ Pass
6	Admin Verification	Validate and update submission status	Status changes automatically	✓ Pass
7	File Upload & Document Reply	Upload and download documents	Files processed correctly	✓ Pass
8	Status Notification	Display real-time status changes	Notifications triggered	✓ Pass
9	Report Printing	Generate structured reports	Reports printed neatly	✓ Pass
10	Logout & Session Security	End session securely	Logout successful	✓ Pass

All system features passed the functional testing phase, indicating that the system operates reliably and aligns with predefined specifications.

User Acceptance Test (UAT)

Table 2. User Satisfaction Assessment (Likert Scale 1–5).

Evaluation Dimension	Indicator	Average Score	Category
Ease of Use	Interface clarity, navigation simplicity	4.70	Excellent
System Efficiency	Speed and responsiveness	4.60	Excellent
Interface Design	Visual appeal and consistency	4.50	Good
Reliability	System stability and error-free performance	4.80	Excellent
Overall Mean		4.65	Excellent

The average score of 4.65 indicates that users were highly satisfied with SIMPENDA's performance, especially regarding reliability and ease of use. The findings confirm that the system's user interface and technical design effectively meet the operational needs of government employees.

The research findings demonstrate that SIMPENDA provides a practical digital solution to improve efficiency and accuracy in personnel and pension data management. This aligns with the Information System Success Model (DeLone & McLean, 2003), emphasizing that system quality and information quality significantly influence user satisfaction.

Furthermore, high levels of user acceptance reinforce the Technology Acceptance Model (TAM) (Davis, 1989), particularly in terms of perceived usefulness and ease of use. Employees perceived the system as beneficial in simplifying administrative procedures and accelerating retirement processing.

From an e-Government maturity perspective (Andersen & Henriksen, 2006), SIMPENDA has reached the integration stage—where internal service processes across departments are interconnected within a centralized platform. This marks an important milestone in the digital transformation of the Kudus Regency government, supporting national initiatives toward efficient, transparent, and responsive governance.

5. CONCLUSION AND RECOMMENDATIONS

This study successfully designed and developed the SIMPENDA (Pension and Personnel Data Information System) as a web-based digital solution to enhance administrative efficiency within the Department of Agriculture and Food of Kudus Regency. The testing results confirmed that all core system functions operated effectively, achieving a high level of user satisfaction (average score 4.65). SIMPENDA integrates personnel management and pension processing in a secure, user-friendly, and accurate platform. Its implementation has streamlined verification procedures, minimized administrative errors, and improved transparency and accountability in civil service administration. For future development, it is recommended that SIMPENDA be integrated with broader regional or national personnel databases (e.g., BKD and BKN systems) and migrated toward a cloud-based architecture to ensure scalability and long-term data security. Further studies are encouraged to assess the system's impact on organizational performance and employee satisfaction, enabling SIMPENDA to serve as a sustainable model for digital personnel management across other government institutions.

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