

Design and Development of an E-Notary System for Document Workflow Monitoring to Improve Efficiency: A Case Study at Miranda, S. H., M. Kn. Notary Office

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ABSTRACT

At Miranda Notary Office, document administration was characterized by fragmented physical and digital storage, manual status confirmation, and repeated coordination, which reduced workflow visibility and increased administrative effort. Previous notarial information-system studies have largely focused on individual functions such as archiving, deed administration, or document monitoring, leaving limited evidence on integrated workflow systems evaluated from functional, operational, and economic perspectives. This study aimed to design, develop, and evaluate a web-based E-Notary system using the Research and Development approach with the ADDIE model. Data were collected through observation, interviews, and office documentation. The system integrates document registration, receipt generation, approval and revision management, workflow monitoring, notifications, client management, and digital archiving. Evaluation employed Black Box Testing, Time and Motion Study, and Cost-Benefit Analysis. All tested system functions operated according to the specified requirements. The digital workflow achieved 72.95% time efficiency, 75.45% motion efficiency, and 74.20% overall operational efficiency, while the Benefit-Cost Ratio reached 1.67. These findings indicate that integrated workflow digitalization can improve administrative efficiency, workflow visibility, and economic feasibility in the studied notary-office setting by reducing repeated searching, data entry, manual confirmation, and unnecessary waiting activities.

Keywords: E-Notary; Document Workflow Monitoring; Operational Efficiency; Time and Motion Study; Cost-Benefit Analysis



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INTRODUCTION

Digital systems increasingly influence how organisations coordinate work, access information, and control routine activities. Aris et al. (2024) found that perceived usefulness and ease of use significantly influence behavioural intention toward an academic information system, while behavioural intention subsequently affects its actual use. Although their study was conducted in higher education, the findings suggest that organisational benefits from digital systems depend on

how effectively users incorporate the technology into their work practices. Jordan et al. (2022) further demonstrated that electronic document management can affect organisational workflows, resource use, and broader digital transformation. These findings provide a basis for viewing digitalisation as a redesign of information-intensive work rather than merely a conversion from paper to electronic records. Notarial administration is particularly dependent on accurate information exchange because a document passes through several related activities before completion. Syahfitri & Harahap (2024) found that manual client-file management in a notary office created difficulties in monitoring work progress, locating work data, and handling administrative records. Apriliosusworo et al. (2022) identified difficulties in locating deed documents and monitoring their processing when supervision was still performed manually. These findings indicate that inefficient document administration may stem more from how information moves between activities than from document storage alone. Consequently, registration, verification, approval, progress monitoring, client management, and archiving need to be treated as interconnected components of a single operational process. This situation was also observed at Miranda Notary Office in Gowa Regency, South Sulawesi. The office employs five staff members, comprising two field personnel and three employees responsible for deed preparation, and processes approximately twelve documents each month. Before the E-Notary system was developed, physical records were maintained in manual archives, while electronic files were scattered across individual staff computers. Document progress was often confirmed via direct communication or messaging apps, leaving information about ongoing work dependent on repeated interpersonal confirmation. Preliminary measurements recorded average completion times of 04:14 for document registration and receipt preparation, 02:32 for notary approval, 02:49 for staff approval and revision follow-up, 00:58 for progress updating, and 03:14 for client record management. The initial evidence indicates that operational inefficiency at Miranda Notary Office resulted from information fragmentation across several stages of document processing. Jordan et al. (2022) reported that conventional document-management practices can restrict efficient workflow management, whereas electronic document-management systems provide opportunities to reorganise document-related work. In the observed office, users had to alternate among physical archives, separate computer files, and communication channels when retrieving information or checking document progress. The absence of a shared source of workflow information also made real-time status checking dependent on confirmation from another user. As a result, searching, switching between information sources, repeated communication, and waiting became additional actions within routine administrative work. Previous research on system development in notarial settings shows that digital applications can address specific weaknesses of conventional administration. Romindo (2019) reported that a web-based archival application facilitated the storage and retrieval of records in a notary office, while Lutfi & Rahasti (2022) developed a digital archive system, with users reporting that it addressed existing archival problems. Hasanah et al. (2023) likewise developed an information system for deed preparation in response to administrative practices that relied on stored files and repetitive processing. Taken together, these studies show that digital systems can improve specific activities related to document storage, retrieval, and deed administration. Nevertheless, the improvements reported in these studies primarily concern specific functions rather than the complete sequence of document processing.

The research gap becomes clearer when document administration is examined as an integrated workflow rather than as a collection of independent functions. Apriliosusworo et al. (2022) developed management and monitoring functions for deed documents, while Syahfitri & Harahap (2024) developed a web-based E-Notary application to address manual client file management and document service administration. These studies broaden the scope beyond archival storage. Yet the reviewed systems do not simultaneously evaluate an integrated workflow that encompasses registration, receipt generation, notary approval, staff revision handling, progress monitoring, notifications, client management, and digital archiving. Moreover, their evaluation emphasis differs from that of the present study, which combines functional verification with direct measurements of processing time, work movements, and economic feasibility. The present research therefore addresses both a functional integration gap and an evaluation gap in the digital management of notarial workflows.

In response to these gaps, this study develops a web-based E-Notary system that centralises document information and connects the principal stages of document administration at Miranda Notary Office. The developed platform integrates document registration, receipt generation, approval and revision management, workflow progress monitoring, notifications, client management, and digital archiving. Its functional performance is examined through Black-Box Testing, whereas operational change is evaluated through a Time-and-Motion Study comparing manual and digital work procedures. Cost-Benefit Analysis is subsequently applied to determine whether the measurable benefits generated through implementation are reasonable relative to the required costs. Accordingly, the contribution of this study lies in integrating a notarial workflow system with functional, operational, and economic evidence from its implementation in an actual office environment.

THEORETICAL FRAMEWORK

Digital transformation can be understood as an organisational change in which digital technologies are incorporated into existing activities to alter how information and work are managed. Jordan et al. (2022) found that electronic document management affects organisational workflows, resource utilisation, and the broader process of digital transformation. Their findings indicate that the value of digitalisation is not limited to replacing paper documents with electronic files but also involves reorganising how information is stored, accessed, and used during daily operations. This perspective is relevant to notarial administration because document registration, verification, approval, progress monitoring, client management, and archiving are connected stages rather than isolated activities. Therefore, digital transformation in a notary office should focus on ensuring continuity of information across these stages rather than merely digitising individual records. The operational contribution of an information system also depends on whether its functions are useful and can be incorporated into users' actual work practices. Aris et al. (2024) found that perceived usefulness and ease of use influenced behavioural intention toward an academic information system, while behavioural intention significantly affected actual system use. Although the organisational context differs from that of notarial services, the study demonstrates that the mere availability of technology does not automatically yield operational value. In the present study, the E-Notary system is therefore conceptualised as a shared operational environment in which information generated during one activity can be reused by users performing subsequent activities. Centralised access to documents, approval records, workflow status, notifications, and client information is expected to reduce dependence on separate files, devices, and informal communication.

This mechanism directly corresponds to the previous working conditions identified at Miranda Notary Office. Document information had been distributed across physical archives, individual computers, and communication applications, requiring users to take additional steps to retrieve records or check workflow status. The developed E-Notary system consolidates these activities by integrating document registration, receipt generation, approval and revision management, progress monitoring, notifications, client management, and digital archiving into a single platform. Information recorded during an earlier stage consequently remains available for later stages without requiring users to recreate the same record or repeatedly request confirmation. In this framework, centralisation serves to reduce information fragmentation rather than merely as a digital storage solution. The relationship between workflow integration and operational efficiency can be further examined through Time and Motion Study. Shetty et al. (2024) demonstrated through a prospective time-and-motion study that an integrated digital workflow reduced total process time, the number of data fields recorded, and resource requirements compared with the existing workflow. In contrast, Calder-Sprackman et al. (2021) found that introducing an electronic health record altered work allocation but did not automatically restore physician efficiency to its pre-implementation level. Taken together, these studies suggest that efficiency does not emerge simply because a process becomes digital; it depends on how effectively the technology reorganises and simplifies the underlying workflow. For the E-Notary system,

efficiency is therefore expected to arise when repeated data entry, document searching, movement between information sources, manual confirmation, and waiting activities can be eliminated or reduced.

Accordingly, this study conceptualises the relationship between E-Notary implementation and operational efficiency as a sequence of process changes rather than as a direct technological effect. Jordan et al. (2022) showed that electronic document management can influence workflow organisation, while Shetty et al. (2024) demonstrated that greater digital integration can reduce both processing time and resource requirements. Drawing on these findings, the E-Notary system first centralises information and connects workflow functions that were previously dispersed across different media. This integration is expected to reduce non-value-added activities, thereby decreasing the elapsed time and the number of operational actions required to complete recurring document-management tasks. Processing time and work movements are therefore used in this study as observable indicators of the operational consequences of workflow integration. Empirical research in notarial settings provides additional support for individual elements of this framework. Previous studies have developed digital systems that address functions such as document archiving, deed administration, registration, monitoring, and client data management (Apriliosuworo et al., 2022; Hasanah et al., 2023; Lutfi & Rahasti, 2022; Romindo, 2019; Syahfitri & Harahap, 2024). These studies indicate that digital applications can resolve specific administrative difficulties, but their functional scope and evaluation approaches generally address particular parts of the workflow. The present framework extends this evidence by connecting multiple administrative functions to an explicit process mechanism in which centralisation and workflow integration are expected to reduce processing time and work movements. Functional performance is evaluated first to establish that the system operates as intended; operational efficiency is then assessed through Time and Motion Study; and economic feasibility is examined separately to determine whether the measurable benefits are reasonable relative to implementation costs

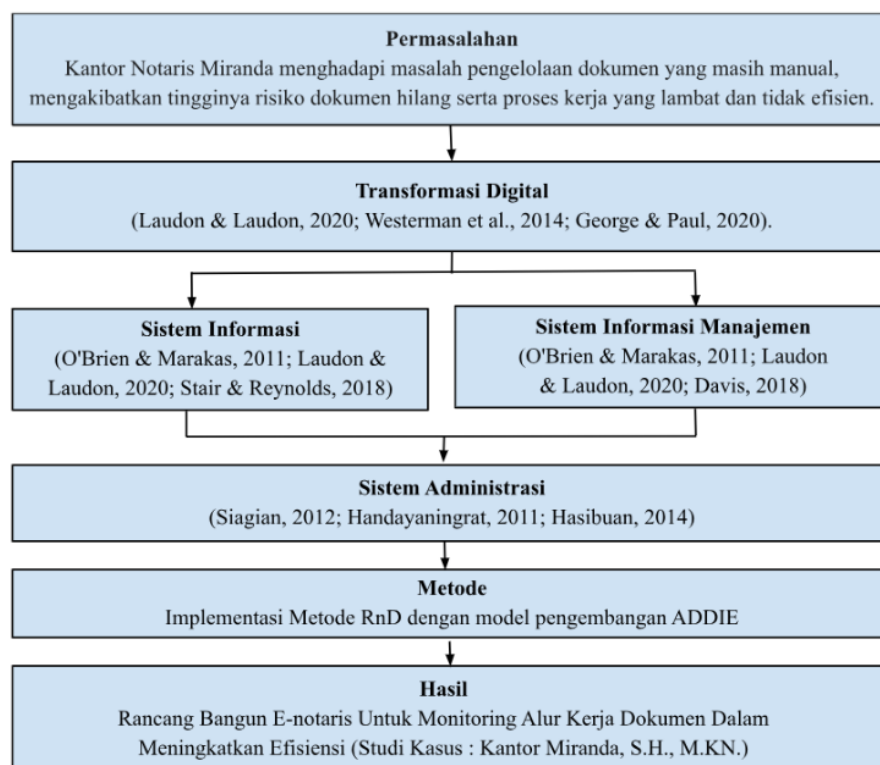


Figure 1. Conceptual Framework

METHODS

This study employed a Research and Development (R&D) design to develop and evaluate a web-based E-Notary system for document workflow management at the Miranda Notary Office in Gowa Regency, South Sulawesi, Indonesia. The approach was selected because the research involved identifying an operational problem, constructing a digital solution, implementing the resulting system, and assessing its performance in the actual work setting. Recent development studies have similarly employed structured development processes to link problem identification to system construction and subsequent evaluation (Lamonge & Baua, 2023; Musa et al., 2024). In particular, the ADDIE framework provides sequential stages through which requirements identified during analysis can be translated into design, development, implementation, and evaluation activities. Accordingly, the present study used ADDIE to maintain continuity between the operational problems observed in the office and the solution developed to address them.

During the Analysis stage, observations, interviews, and office records were examined to identify workflow constraints and user requirements. The Design stage transformed these findings into specifications covering system architecture, user interactions, database relationships, and interface structure, while the Development stage converted the specifications into a functional web application. The completed system was subsequently introduced to the office during the Implementation stage, enabling users to perform document-related activities within the digital workflow. A comparable application of ADDIE by Lamonge & Baua (2023) also began with needs identification before proceeding to web-based development and evaluation, while Musa et al. (2024) demonstrated the usefulness of maintaining explicit links among the successive phases of ADDIE. The final Evaluation stage in this study therefore examined whether the developed E-Notary system met its requirements and whether its implementation yielded operational and economic benefits. The study population consisted of all personnel directly involved in document workflow activities at Miranda Notary Office, comprising one notary and five employees. Because the entire relevant operational population participated, no separate sample was selected. The five employees included two field staff members and three employees responsible for deed preparation. At the same time, the notary participated because of her role in document review, workflow supervision, and processing decisions. Their involvement enabled the study to represent both operational and supervisory perspectives on the manual process and the subsequent use of the E-Notary system.

Research data were collected through direct observation, interviews, and office documentation, with each source serving a different role in identifying requirements and evaluating the resulting system. Observation was used to reconstruct the existing workflow, interviews identified user difficulties and functional needs, and administrative records were reviewed to determine how information was created, stored, retrieved, and transferred. Functional performance was subsequently examined through Black Box Testing by comparing actual outputs with the responses expected from predefined test scenarios. Similar studies have applied Black Box Testing to web-based information systems to determine whether externally observable functions conform to specified requirements without examining the internal program structure (Wulandari et al., 2022; Zulkarnaini et al., 2023). The test scenarios in the present study covered authentication, document management, receipt generation, approval handling, workflow updates, notifications, client management, and account settings. Operational efficiency was examined through a Time and Motion Study comparing equivalent activities under the manual and E-Notary workflows. Time-and-motion approaches have been used in digital-system evaluations to quantify changes in task duration, workflow structure, task switching, and operational activity after technological interventions (Dolan et al., 2023; Hicks et al., 2024; Moy et al., 2021; Zavodni et al., 2023). These studies support the use of direct workflow observation when the objective is to determine whether digital integration changes the amount of time or activity required to complete comparable work. The present evaluation covered document registration and receipt generation (T1), notary approval (T2a), staff approval and revision follow-up (T2b), workflow progress updating (T3), and client record management (T4). Each activity was examined under equivalent manual and digital

conditions so that differences could be attributed to changes in the workflow rather than to differences in the task being performed.

For the Time Study, task duration was measured with a stopwatch, using consistent starting and completion points for both conditions, and waiting periods within the observed process were included in the elapsed time. Direct observation and explicit task classification have also been used in previous Time and Motion Studies to distinguish workflow activities and quantify changes following the implementation of digital systems (Dolan et al., 2023; Hicks et al., 2024). Each applicable participant completed two measurement trials under the manual and digital conditions, and the mean duration was used as the representative task value. Monthly workload estimates were then derived by applying the observed durations to the actual recurring frequency of each activity, rather than giving identical weight to tasks that occurred at different rates. This frequency-weighted approach enabled the resulting efficiency measure to reflect the office's estimated monthly operational workload. To reflect the office's actual workload rather than treating all tasks as equally frequent, task durations were converted into estimated monthly workloads. The office handled approximately 12 documents per month. Accordingly, T1 was assigned a frequency of 12 occurrences per month. Approval activities (T2a and T2b) were estimated at 36 occurrences per month because each document typically underwent three review cycles. Progress updating (T3) was estimated at 6 updates per document, resulting in 72 occurrences per month. Client record management (T4) was likewise estimated at 72 occurrences per month because supporting and final document records were accessed or updated repeatedly during the document-processing phase. The monthly manual and digital durations were obtained by multiplying each activity's representative duration by its frequency and summing the results. The percentage reduction between the aggregated manual and digital workloads was then used as the overall time-efficiency measure.

The Motion Study examined the number of operational actions required to achieve equivalent outcomes under the two workflows. Workflow activities were mapped sequentially, allowing repeated data entry, document searching, transitions between information sources, status confirmation, and waiting to be identified as potential sources of process burden. Moy et al. (2021) demonstrated that time-motion observations can reveal workflow fragmentation and task switching associated with information-system use, while Zavodni et al. (2023) quantified both time and manual data-transcription activities when comparing conventional and integrated digital workflows. For approval procedures involving alternative outcomes, the representative digital motion count was calculated from the mean of the observed approval and revision scenarios before monthly frequency weighting was applied. Overall operational efficiency was subsequently obtained by combining the calculated time-efficiency and motion-efficiency measures. Motion efficiency was determined using: For approval activities with alternative digital outcomes, such as direct approval and revision, the representative motion count was calculated as the mean of the evaluated scenarios before the corresponding monthly frequency was applied. The overall operational efficiency measure was subsequently calculated as the arithmetic mean of time efficiency and motion efficiency:

Economic feasibility was evaluated through a Cost-Benefit Analysis by comparing the measurable benefits attributable to the E-Notary system with the costs of development and implementation. Recent empirical evaluation of digital information systems has similarly compared implementation and operating costs with the economic consequences of replacing or reorganising conventional information-management processes (Federici et al., 2025). Their multicountry study also demonstrates that economic outcomes depend on implementation conditions and on the extent to which digital procedures replace rather than merely duplicate existing manual processes. In the present study, feasibility was assessed using the Benefit-Cost Ratio (BCR), with a value exceeding 1 indicating that estimated benefits exceeded identified costs (Pannell et al., 2024). This economic evaluation was treated separately from functional and operational testing so that technical performance, workflow efficiency, and financial feasibility represented distinct dimensions of system evaluation.

A BCR greater than one indicates that the estimated benefits exceed the associated costs and therefore supports the economic feasibility of the system.

RESULTS AND DISCUSSION

Analysis Stage

The analysis stage combined observation, interviews, and office documentation to identify the main weaknesses in document management at Miranda Notary Office. The findings indicated that document recording, status monitoring, and archive handling were still fragmented across manual procedures, physical files, and individual staff devices. Because progress information often depended on direct communication, users had to repeatedly confirm document status, which slowed monitoring and delayed updates. The absence of centralised storage also made document retrieval less efficient and increased dependence on particular staff members who held relevant files or information. These conditions reduced information accessibility and increased operational risk due to document loss, delayed retrieval, and incomplete visibility into workflows.

Table 1. Problem Identification

No	Main Issue	Operational Impact
1.	Document management and recording are still performed manually	Inefficient work processes and longer processing times
2.	Document status information is not centrally documented	Difficulties in monitoring work progress in real time
3.	Document archiving is not integrated and lacks structured management	Longer archive retrieval time and dependence on specific staff members

Based on these findings, the system requirements were formulated to support centralised document recording, real-time workflow monitoring, and integrated digital archiving. These requirements served as the foundation for developing the proposed E-Notary system.

Table 2. System Requirements Based on Identified Problems

No	System Requirement	Description
1.	Centralized document recording system	Ensures document data are recorded consistently and easily accessible
2.	Document workflow monitoring system	Enables real-time monitoring of document progress
3.	Integrated digital archiving system	Improves archive accessibility and reduces dependence on individual devices

Design Stage

The design stage translated the identified system requirements into a comprehensive blueprint for the proposed E-Notary system. The design process focused on defining user interactions, database structures, and interface layouts to ensure the system could effectively support document management, workflow monitoring, and digital archiving. The system was designed to accommodate two primary actors: staff and notaries, each with distinct roles and access permissions.

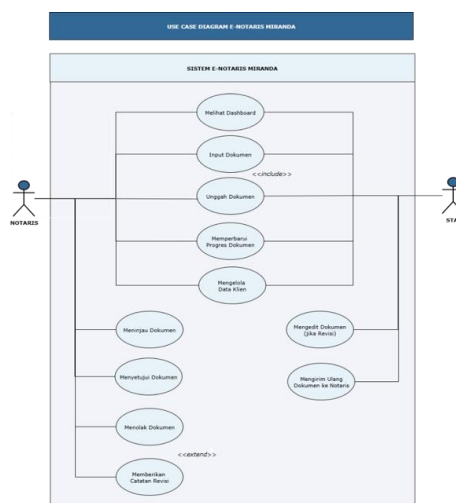


Figure 2. Use Case Diagram

The Use Case Diagram defines how the two primary user groups interact with the E-Notary system in line with their operational responsibilities. Staff members handle document registration, supporting file uploads, progress updates, and revision activities throughout the document workflow. Notaries perform supervisory and decision-related functions, including document review, approval or revision decisions, progress monitoring, and client data management. This separation of functions establishes clear access responsibilities while allowing both actors to participate within the same integrated workflow. The diagram therefore represents the system boundaries, user roles, and principal interactions required to support document processing at Miranda Notary Office.

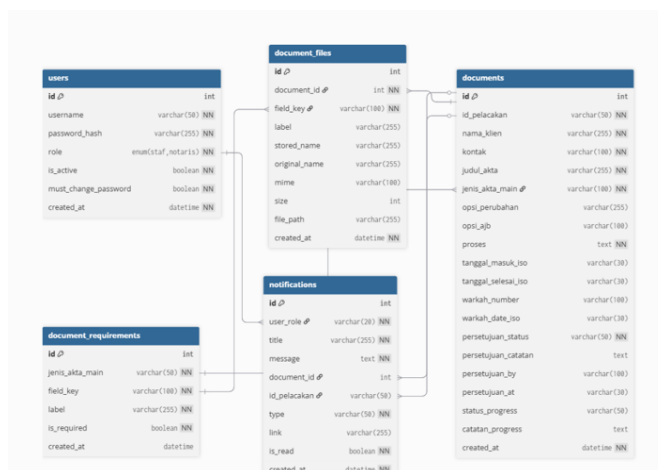


Figure 3. Entity Relationship Diagram (ERD)

An Entity Relationship Diagram (ERD) was constructed to define how data are organised and connected within the E-Notary database. The database architecture comprises five principal entities: users, documents, document requirements, document files, and notifications. Each entity represents a specific component of the document-management process and is linked through defined primary and foreign keys. These relationships maintain consistency among related records while minimising disconnected or duplicated data. The resulting database structure supports document administration, file handling, workflow tracking, and automated notification processes within an integrated system.

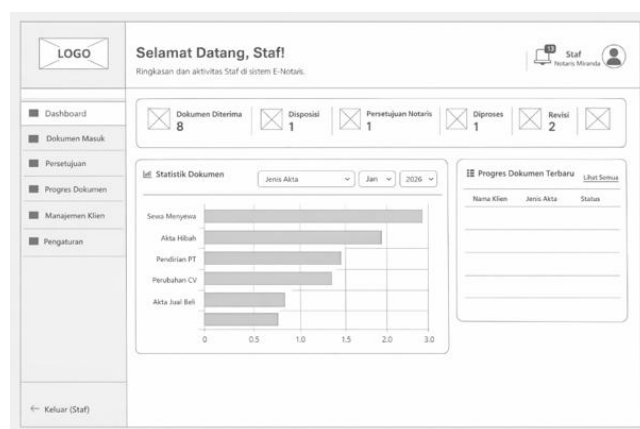


Figure 4. E-Notary Dashboard Interface

The user interface was designed to provide a clean, practical environment for routine document management tasks. The dashboard serves as the primary access point, presenting document statistics, workflow status, notifications, and navigation options on a single screen. Its layout was organised to minimise unnecessary complexity and help users locate relevant information without moving through multiple interfaces. Consistent visual elements and straightforward navigation were applied to support ease of use during daily operations. This design was intended to make document monitoring and administrative control more accessible for users at Miranda Notary Office.

Development Stage

During the Development stage, the approved system design was converted into a functional web-based E-Notary application using PHP and MySQL. The implementation covered the previously defined system architecture, database structure, and user interface, while integrating document management, workflow monitoring, approval handling, client management, notifications, and digital archiving into a single platform. Role-based access control was applied to distinguish responsibilities between staff and notaries, with staff handling registration, file uploads, document updates, and revisions. In contrast, notaries performed document review, approval decisions, workflow supervision, and client management. The integration of these modules created a centralised environment in which information could be accessed and processed according to each user's operational role. As a result, the developed system provided a more structured digital workspace to support coordination, information accessibility, and daily administrative activities at Miranda Notary Office.

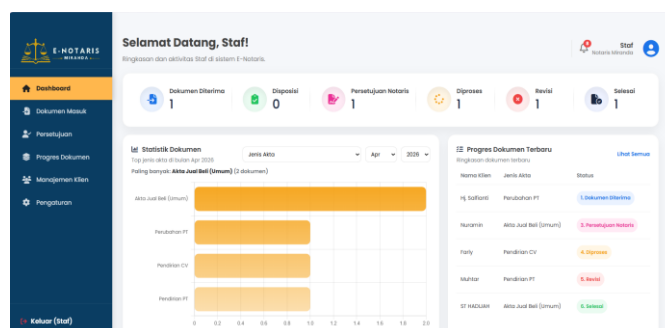


Figure 5. E-Notary System Dashboard

Implementation Stage

During the Implementation stage, the E-Notary system was introduced at the Miranda Notary Office and used by the notary and staff to perform routine document management activities. Users performed document registration, file submission, approval, workflow monitoring, revision

handling, client management, and digital archiving via the developed platform, in accordance with their respective access rights. Role-based access control ensured that staff focused on operational tasks such as registration, uploads, updates, and revisions. At the same time, the notary handled document review, approval decisions, workflow supervision, and client information. The centralised platform enabled access to document records, workflow status, notifications, and operational summaries within the same environment, reducing reliance on separate files and manual confirmation. These implementation results indicate that the system supported daily administrative processes more systematically while improving information accessibility, coordination, and real-time visibility of document progress.

Evaluation Stage

The evaluation stage assessed the functionality, efficiency, and economic feasibility of the E-Notary system. Three evaluation methods were applied, namely Black Box Testing, Time and Motion Study, and Cost-Benefit Analysis (CBA). The evaluation aimed to determine whether the developed system met user requirements, improved operational efficiency, and delivered economic value to the organisation.

Black Box Testing

Black Box Testing was conducted to determine whether the E-Notary system's main functions complied with the predefined functional requirements. The assessment included authentication, document management, workflow tracking, approval processing, client management, notification services, and account settings. Each test scenario compared the actual system response with the expected output defined during system design. The results showed that all evaluated modules produced the intended responses without functional discrepancies. These findings indicate that the developed E-Notary system met its specified functional requirements and was ready to support the subsequent operational evaluation.

Table 3. Black Box Testing Results

No	Module	Test Scenario	Result
1	Authentication	User login and logout	Valid
2	Dashboard	Display operational information	Valid
3	Document Management	Register and update documents	Valid
4	Workflow Monitoring	Track document progress	Valid
5	Approval Management	Approve and revise documents	Valid
6	Notification System	Generate system notifications	Valid
7	Client Management	Add and manage client data	Valid
8	Account Settings	Update user profile settings	Valid

The completion of all predefined test scenarios indicates that the E-Notary system satisfied the functional requirements established during system design. Core activities such as document registration, workflow tracking, approval handling, and digital archiving were executed in accordance with the expected system responses. No functional discrepancies were identified in the tested modules, providing evidence that the main features operated consistently within the evaluation scope. This functional performance supports the use of the system for routine administrative processes at Miranda Notary Office. Accordingly, the system was considered sufficiently reliable to proceed to operational efficiency and economic feasibility assessment.

Time and Motion Study

A Time and Motion Study was used to measure how the E-Notary system changed both task duration and the number of operational actions required during document processing. The assessment covered document registration and receipt generation (T1), approval management (T2), workflow progress updating (T3), and client record management (T4). Because approval activities involved different responsibilities, T2 was separated into notary approval (T2a) and staff approval with revision follow-up (T2b). Each activity was examined under both manual and digital conditions, using identical workflow procedures to ensure comparability. Monthly task frequencies were then applied to the observed values so that the efficiency analysis reflected the office's actual recurring workload rather than isolated task measurements.

Table 4. Time Study Results and Monthly Aggregation

No	Task	Manual Time	E-Notary Time	Time Reduction
1	T1 – Document Registration and Receipt	04:14	02:06	50.39%
2	T2 – Approval Management	02:41	00:39	75.78%
3	T3 – Workflow Progress Update	00:58	00:25	56.90%
4.	T4 – Client Record Management	03:14	00:38	80.41%

Table 4 indicates that the implementation of the E-Notary system reduced processing time across all evaluated activities, with the greatest task-level improvement occurring in staff approval and revision follow-up (T2b), followed by client record management (T4). At the same time, document registration and receipt generation (T1) showed the smallest reduction. To derive the aggregate time-efficiency value, the representative duration of each activity was weighted by its estimated monthly frequency, producing a total monthly processing time of 09:05:48 for the manual workflow and 02:27:36 for the digital workflow. Based on these weighted values, the E-Notary system achieved a time efficiency of 72.95%. The evaluation was then extended through a Motion Study to examine changes in the number of operational actions required to complete the same tasks. The analysis showed that the digital workflow reduced several non-value-added activities and simplified the sequence of work movements involved in routine document processing.

Table 5. Motion Study Results and Monthly Aggregation

No	Task	Manual Work Steps	E-Notary Work Steps	Reduction
1	T1 – Document Registration and Receipt	42	14	66.67%
2	T2 – Approval Management	37	14	62.16%
3	T3 – Workflow Progress Update	45	11	75.56%
4.	T4 – Client Record Management	58	11	81.03%

Note: For T2a and T2b under the digital condition, the representative motion count was calculated as the mean of the evaluated approval and revision scenarios. T2a required 11 motions for direct approval and 13 motions when a revision note was included, resulting in a representative value of 12 motions. T2b required 9 motions for the approval scenario and 14 for the revision-and-re-upload scenario, yielding a representative value of 11.5 motions. Table 5 shows that the digital

workflow required considerably fewer operational actions than the previous manual procedure. The greatest reduction was recorded in client record management (T4), while workflow progress updating (T3) produced the next largest improvement. After the representative motion values were weighted by the estimated monthly frequency of each activity, total movements decreased from 10,584 per month under the manual workflow to 2,598 per month after E-Notary implementation. This difference corresponds to an aggregate motion efficiency of 75.45%. The reduction indicates that the integrated system simplified routine work by limiting repeated document searches, duplicate recording, movement across different information media, and manual coordination.

Table 6. Time and Motion Study Results

No	Indicator	Result
1	Time Efficiency	72.95%
2	Motion Efficiency	75.45%
3	Overall Efficiency	74.20%

The combined evaluation results show that the E-Notary system improved operational efficiency in terms of both processing time and work movements. The time-efficiency measure was 72.95%, while motion efficiency was 75.45%. Averaging these two indicators produced an overall operational efficiency value of 74.20%. This result indicates that the improvement resulted from two related changes: shorter completion times for recurring administrative tasks and fewer operational actions required in the document workflow. Accordingly, the digital system contributed to a more streamlined work process by reducing both temporal and procedural burdens in document administration.

Economic Feasibility Evaluation

A Cost-Benefit Analysis (CBA) was conducted to evaluate the economic feasibility of implementing the E-Notary system. The analysis considered implementation and operational costs, as well as measurable benefits from improved efficiency and reduced administrative risks.

Table 6. Cost-Benefit Analysis Results

No	Component	Value
1.	Total Cost	Rp3,200,000
2.	Total Benefit	Rp5,349,168
3.	Net Benefit	Rp2,149,168
4.	Benefit-Cost Ratio (BCR)	1.67

The economic assessment showed that implementation of the E-Notary system generated a net benefit of Rp2,149,168 and a Benefit-Cost Ratio (BCR) of 1.67. Because the BCR exceeded the feasibility threshold of 1.00, the estimated benefits exceeded the costs of developing and operating the system. This result indicates that the digital workflow was not only operationally useful but also economically justifiable within the evaluated setting. The positive net benefit further suggests that efficiency gains and reductions in administrative risk produced measurable value for the office. Therefore, the system is economically feasible for supporting document management activities at the Miranda Notary Office.

Integrated E-Notary Development and Functional Performance

The findings show that the principal problem at the Miranda Notary Office stemmed from fragmented information and workflow processes rather than from the use of paper documents alone. Document records were distributed across physical archives, individual computers, and separate communication channels, requiring users to search for information and repeatedly confirm workflow status. Jordan et al. (2022) similarly found that fragmented document-management practices can restrict information accessibility and workflow coordination. In contrast, digital document management can support broader organisational transformation. In response to this condition, the developed E-Notary system connected document registration, receipt generation, approval and revision management, workflow monitoring, notifications, client records, and digital archiving within a single operational environment. The resulting integration therefore represents a redesign of how information moves through the document process rather than merely a conversion of conventional records into digital files.

The functional evaluation further demonstrated that the integrated design could meet the specified system requirements. Black Box Testing confirmed that authentication, document management, workflow monitoring, approval processing, notifications, client management, and account settings produced the expected system responses. This result is important because the operational value of an information system depends on whether its functions can be consistently incorporated into users' actual work activities; Aris et al. (2024) likewise demonstrated that actual system use is closely related to how users perceive and engage with information-system functionality. Studies in notarial settings have also reported that digital applications can improve archive management, document accessibility, deed administration, and workflow monitoring (Apriliusworo et al., 2022; Hasanah et al., 2023; Lutfi & Rahasti, 2022; Syahfitri & Harahap, 2024). The present study extends these findings by treating functional reliability not as the final measure of success but as a prerequisite for determining whether an integrated digital workflow produced measurable changes in operational performance.

Operational Efficiency Through Workflow Integration

The Time Study provides evidence that workflow integration reduced the time required to perform recurring document management activities. The frequency-weighted workload decreased from 09:05:48 under the manual workflow to 02:27:36 under the E-Notary procedure, representing a 72.95% reduction in time. The reduction was not uniform across tasks, with staff approval and revision follow-up producing the largest improvement, while document registration and receipt generation showed the smallest proportional decrease. This pattern is consistent with the proposition that digitalisation improves performance by removing avoidable coordination and information-handling activities rather than eliminating essential work itself. Shetty et al. (2024), for example, found that an integrated digital workflow could reduce process time and resource requirements. In contrast, Calder-Sprackman et al. (2021) demonstrated that the introduction of digital technology does not automatically improve every aspect of work efficiency.

The Motion Study strengthens this interpretation because the improvement was also reflected in the number of operational actions needed to complete the same administrative outcomes. Monthly work movements decreased from an estimated 10,584 under the manual condition to 2,598 under the digital workflow, producing a motion efficiency of 75.45%. In comparison, the combined time-and-motion indicators yielded an overall operational efficiency of 74.20%. The largest motion reduction occurred in client record management, where centralised records reduced the need to search among physical archives, local computer folders, and communication histories. These results support the process mechanism proposed in the theoretical framework: information centralisation and workflow integration reduce repeated data entry, cross-media movement, document searching, manual confirmation, and waiting activities. Previous notarial system studies have shown improvements in document retrieval, monitoring, and administrative accessibility (Apriliusworo et al., 2022; Lutfi & Rahasti, 2022; Romindo, 2019), whereas the present findings extend this evidence by demonstrating a measurable reduction in both elapsed time and the number of actions involved in completing routine work. The differences among task-level

efficiency values also show that the operational benefit of an E-Notary system depends on the characteristics of each activity. Document registration still requires client data entry, document checking, and receipt confirmation, meaning that several value-adding steps cannot reasonably be removed even after digitalisation. In contrast, approval follow-up, progress monitoring, and client-record retrieval contain a larger proportion of activities that can be simplified through shared records, automatic notifications, and centralised workflow information. This observation reinforces the argument that technology itself is not the direct source of efficiency; improvements result from changes in how information is created, accessed, communicated, and reused. Therefore, the operational contribution of the E-Notary system lies primarily in removing unnecessary process burden while preserving administrative activities required for document accuracy and control.

Economic Feasibility, Research Contribution, and Practical Implications

A positive economic outcome accompanied the operational improvements. Cost-Benefit Analysis produced a net benefit of Rp2,149,168 and a Benefit-Cost Ratio of 1.67, indicating that the estimated benefits exceeded the identified development and operating costs. This interpretation is consistent with cost-benefit decision criteria in which a BCR above one supports the economic acceptability of an intervention (Boardman et al., 2018; Pannell et al., 2024). Importantly, the estimated value was not derived solely from shorter processing time, but also from reductions in administrative risks associated with misplaced documents, delays, recording errors, and repeated paper-based activities. The economic result, therefore, suggests that integrated document management can generate value through both productivity improvements and better control over recurring administrative risks. From a research perspective, the study contributes by combining system integration with functional, operational, and economic evaluation within a single notarial workflow. Earlier studies have demonstrated the usefulness of digital systems for archiving, deed administration, document monitoring, and client data management (Hasanah et al., 2023; Lutfi & Rahasti, 2022; Syahfitri & Harahap, 2024), but these functions have often been examined separately. The present study connects document intake, approval and revision, progress monitoring, notifications, client management, and archiving. Then it evaluates their consequences through Black Box Testing, Time and Motion Study, and Cost-Benefit Analysis. This combination provides a broader assessment than evaluating functionality or perceived usefulness alone because it links system performance to observable workflow changes and economic consequences. Nevertheless, the findings reflect one notary office with one notary, five employees, and its particular workload conditions, so the magnitude of improvement should not be generalised automatically to other settings.

For practical application, the findings suggest that digitalisation of notary offices should prioritise workflow integration rather than focusing solely on electronic storage. Connecting archives with approval, progress monitoring, notifications, and client information reduced dependence on individual devices and repeated interpersonal confirmation within the studied office. Similar implementations in other notarial settings may therefore benefit from first identifying where repeated searching, data duplication, status confirmation, and waiting occur before determining which functions should be digitised. Future research should test the system across multiple notary offices with varying staff structures, transaction volumes, and operating procedures, and observe its use over longer periods. Such evaluation would help determine whether the operational and economic benefits observed at Miranda Notary Office remain consistent under broader implementation conditions.

CONCLUSION

This study successfully designed, developed, and evaluated a web-based E-Notary system to address fragmented document management and workflow monitoring at Miranda Notary Office. By integrating document registration, receipt generation, approval and revision management, workflow progress monitoring, notifications, client management, and digital archiving within a

centralised platform, the system transformed previously dispersed administrative activities into a more structured and traceable workflow. Functional evaluation confirmed that the principal system modules operated in accordance with their intended requirements. In contrast, the operational evaluation demonstrated that the digital workflow reduced processing effort by shortening task completion times and eliminating or simplifying non-value-added activities such as repeated data entry, document searches, cross-media access, manual confirmations, and unnecessary waiting. The economic evaluation further indicated that the benefits generated by implementation were sufficient to support its feasibility within the studied setting. Taken together, these findings show that the contribution of the E-Notary system lies not merely in digitising documents but in integrating interdependent administrative processes in ways that improve workflow visibility, coordination, information accessibility, and operational control. Nevertheless, the findings should be interpreted within the scope of a single notary-office case and a limited operational implementation, meaning that the specific workload, users, and workflow characteristics of Miranda Notary Office may influence the observed improvements. Future research should therefore evaluate the system across multiple notary offices with more diverse operational conditions, larger user groups, and longer implementation periods to determine whether the observed functional, operational, and economic benefits remain consistent in broader settings.

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