

A Web-based Laboratory Document Governance System for Secure Digital Management

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Abstract

This study addresses inefficiencies, security vulnerabilities, and data redundancy in conventional laboratory document management by developing a web-based document governance system named TaKeDoLaSi. The system integrates ISO 15489 records management principles with abb) to support secure, accountable, and traceable digital document governance. The development process adopted the Waterfall System Development Life Cycle (SDLC) methodology, including planning, requirement analysis, database design, implementation, testing, and maintenance. The system was developed using the Python-Flask framework and SQL Alchemy for database management. Data collection and evaluation were conducted through Focus Group Discussions (FGD) and User Acceptance Testing (UAT) involving 15 laboratory personnel selected purposively based on their direct involvement in document management activities. The evaluation assessed operational dimensions including role-based accessibility, document upload and retrieval efficiency, workflow compatibility, interface usability, activity logging, and notification functionality. User satisfaction and system usability were analyzed qualitatively through direct interaction, operational observation, and participant feedback. The scoring criteria were based on the conformity between expected and actual system performance, categorized as "Success" when functional requirements were achieved. The results indicate that all evaluated system functions successfully met the established acceptance criteria. Participants confirmed that the RBAC mechanism effectively controlled access permissions, while document management and monitoring features improved operational efficiency, transparency, and accountability. The findings demonstrate that the proposed system achieved satisfactory usability and user acceptance for governance-oriented laboratory document management.

Keywords: Document Governance System, Role-Based Access Control (RBAC), System Development Life Cycle (SDLC), User Acceptance Testing (UAT), Web-based Archiving.

Introduction

According to the International Organization for Standardization, record management is a systematic process of creating, receiving, maintaining, and controlling documents as evidence of organizational activities to support operations, accountability, and legal compliance. Archives serve as vital information sources, a foundation for decision-making, and administrative proof that ensures organizational continuity (1). A robust filing system not only drives operational efficiency and information accuracy but also safeguards sensitive organizational data. Historically, these systems relied on manual physical media such as folders, filing cabinets, and shelves or basic digital storage via local computer

folders. While these methods offered simplicity and direct access, they were fraught with challenges, including limited storage space, vulnerability to physical damage, and significant hurdles in rapid document retrieval (2). Locating specific files often became a time-consuming ordeal, particularly as archive volumes grew and inconsistent categorization took hold. These traditional systems were frequently plagued by critical issues: documents were often lost or damaged by fire, floods, or natural aging; tracking became nearly impossible due to outdated indices; access remained restricted to a select few; and frequent data redundancy hampered overall workflow efficiency (3). Transitioning into the

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modern era, the landscape of record-keeping has undergone a radical transformation, moving away from these physical constraints toward a more agile, tech-driven approach. With the dawn of computerization, management shifted toward database technologies and document management software, which vastly improved search speeds, data accuracy, and management efficiency (4). Management Information Systems (MIS) have since become cornerstone components for organizational planning, monitoring, and performance evaluation (5). Today, web-based technologies further empower modern archiving by enabling real-time data access, seamless user collaboration, and location-independent integration (6). In this digital climate, transformation is no longer a luxury but a necessity for organizations striving to maintain a competitive edge in the global market.

One of the most significant innovations in this space is cloud computing, which facilitates remote data storage accessible from any device. This technology offers massive storage capacity, enhanced security through encryption, and automated backups to prevent data loss (7). From an organizational standpoint, the cloud reduces infrastructure costs while boosting operational flexibility (8). Recent studies highlight that integrating the cloud with Document Management Systems (DMS) enables automated archiving and comprehensive audit trails, further strengthening accountability (9).

However, the transition is not without its hurdles. Mid-sized organizations often struggle with a lack of governance policies, security misconfigurations, and limited human resource competency (10). Despite the clear advantages of the cloud, many entities still cling to manual or semi-digital methods that remain slow and prone to error (8). Consequently, there is an urgent need for intuitive, web-based applications capable of managing data efficiently and securely. Such systems are expected to streamline core functions storage, deletion, and rapid retrieval especially for organizations dealing with high-volume daily data management.

Archiving Systems and ISO 15489 Standards

Document archiving, or records management, is the systematic process of managing organizational information, encompassing its creation, receipt,

maintenance, and control. According to the International Organization for Standardization via ISO 15489-1:2016, an archiving system aims to support operational efficiency, accountability, and legal compliance within an organization. Records serve as administrative evidence, vital information sources, and the foundation for sustainable decision-making (11). Consequently, an effective archiving system must guarantee the integrity, authenticity, and reliability of documents (3).

Historically, archiving practices were manual, relying on physical media such as folders, racks, and filing cabinets. While straightforward, this method faced significant constraints regarding storage space, physical durability, and retrieval speed (12). These limitations eventually necessitated a technological shift, where advances in information technology drove the transition toward computer-based digital systems, offering superior access speed and data management efficiency (13). Building upon this digital evolution, the emergence of cloud technology has further revolutionized how organizations store and collaborate on their institutional knowledge.

Digitalization and Cloud-based Document Management Systems (DMS)

The dawn of the digital era has fundamentally shifted the organizational paradigm of records management. Modern archiving systems are now integrated with cloud-based Document Management Systems (DMS), enabling real-time storage, collaboration, and data access. The utilization of web-based systems enhances work efficiency through the ability to synchronize across devices regardless of location (14). Cloud computing plays a pivotal role in supporting modern DMS architecture. Cloud-based storage provides vast capacity, security through encryption, and automated backup mechanisms to prevent data loss (15). Furthermore, cloud computing helps organizations reduce infrastructure costs while increasing operational flexibility (8).

Integrating cloud technology into a DMS allows for the automation of archiving processes, version control, and audit trails, all of which bolster data transparency and accountability (16, 17). These findings show that organizations adopting cloud systems achieve 40% faster document tracking compared to traditional systems. Nevertheless, risks may still arise from improper security

configurations and limited user competence (18) because these vulnerabilities can undermine the benefits of the cloud, robust security frameworks and governance policies become indispensable components of the system.

Data Security and Digital Document Governance

Security is a cornerstone of digital archiving systems. Failures in managing access rights, encryption, and user authentication can lead to data breaches that severely damage an organization's reputation. Security encompasses more than just technical protection; it requires a document governance policy that regulates the entire record lifecycle, from creation to disposal. Modern security models in cloud-based DMS integrate Role-Based Access Control (RBAC) to ensure that users only access data relevant to their specific roles. This principle not only maintains confidentiality but also strengthens the accountability of user activities through comprehensive log trails (19, 20). Thus, security and governance act as mutually reinforcing pillars that ensure the sustainability of digital archiving. However, even the most secure system remains ineffective if it is not embraced by those intended to use it.

User Acceptance of Information Systems

The success of a digital archiving system implementation is heavily influenced by the level of user acceptance. The most widely utilized framework for this is the Technology Acceptance Model (TAM) developed (18), which centers on two primary constructs: Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). According to TAM, a system will be accepted if users believe the technology is both beneficial and easy to navigate. The evolution of this model led to the Unified Theory of Acceptance and Use of Technology (UTAUT), which introduced additional constructs such as performance expectancy, effort expectancy, social influence, and facilitating conditions. In the context of digital archiving (20), later studies proved that perceived ease of use and infrastructural support significantly influence the intention to use the system (21-23).

In this study, user acceptance was evaluated through User Acceptance Testing (UAT) to verify the alignment between expected and actual results for each feature. All core functions including role-

based login, file uploading/deletion, and tag/category management successfully met the acceptance criteria. This aligns with the findings, who emphasize that the success of an information system depends not only on its functionality but also on user satisfaction and trust in the system (24, 25).

Conceptual Framework of Digital Document Governance

This study conceptualizes digital document governance as the integration of three interrelated dimensions: records governance, security governance, and user-centered operational usability. This mechanism improves procedural transparency and minimizes the risk of unauthorized document modification or removal. Structured record lifecycle control has been regarded as important for maintaining organizational accountability and preventing information misuse (1).

The first dimension is records governance, which is grounded in ISO 15489 principles emphasizing document integrity, authenticity, reliability, and lifecycle management. Within this perspective, records are treated as organizational evidence that must remain secure, traceable, and systematically maintained throughout their operational lifecycle. The second dimension is security governance, implemented through the Role-Based Access Control (RBAC) model. RBAC enables authorization management by restricting system access according to organizational roles and responsibilities. This mechanism strengthens confidentiality, administrative accountability, and operational monitoring through controlled permissions and activity traceability.

The third dimension is user-centered operational usability, which emphasizes the importance of system acceptance and practical usability within daily organizational workflows. This dimension is informed by the Technology Acceptance Model (TAM), particularly the constructs of perceived usefulness and perceived ease of use, which influence user adoption and operational effectiveness. The interaction among these three dimensions forms the proposed conceptual framework of the study. Accordingly, the developed system is not only intended to improve technical document storage processes but also to operationalize governance principles through secure access control, structured document

classification, activity monitoring, and user-oriented workflow integration.

State of the Art

Existing studies on cloud-based document management systems primarily focus on technical implementation, digital storage efficiency, and cloud infrastructure optimization. Meanwhile, studies concerning information system acceptance mainly emphasize usability, adoption behavior, and user interaction with digital platforms. Although these studies provide important contributions individually, limited research has conceptualized digital document governance as an integrated interaction between governance standards, access-control security, and operational usability within laboratory management environments.

Furthermore, previous studies generally evaluated document management systems from isolated perspectives, such as cloud storage capability, information retrieval efficiency, or user acceptance factors, without systematically integrating governance-oriented mechanisms including Role-Based Access Control (RBAC), auditability, activity traceability, and records governance principles based on ISO 15489 within a unified framework. Accordingly, this study proposes an integrated governance-oriented conceptual architecture that combines ISO 15489 records management principles, RBAC-based authorization mechanisms, and user-centered operational evaluation through User Acceptance Testing (UAT). This integration contributes to the development of a secure, accountable, and operationally adaptive digital document governance model for laboratory environments.

Research Questions

Based on the identified research gaps and organizational challenges, this study seeks to investigate the integration of governance-oriented digital archiving within laboratory operational environments. Accordingly, the study addresses the following research questions:

- a) How can ISO 15489 records management principles and Role-Based Access Control (RBAC) mechanisms be integrated into a web-based laboratory document governance system?
- b) How does the proposed system support secure, traceable, and accountable digital document management within laboratory operational environments?

- c) To what extent does the developed system meet user operational requirements and achieve user acceptance based on Focus Group Discussion (FGD) and User Acceptance Testing (UAT) evaluations?

Methodology

Data Collection

Data collection in this study was conducted through two primary approaches: Focus Group Discussions (FGD) and User Acceptance Testing (UAT). These methods were implemented complementarily to ensure that the developed web-based laboratory document governance system aligned with operational requirements and user expectations. The first stage involved Focus Group Discussions (FGD), which were conducted with laboratory personnel directly involved in document management activities. The discussions aimed to identify operational challenges, understand document management workflows, determine system requirements, and obtain feedback regarding feature relevance and usability. The FGD sessions also served as a participatory mechanism to align the developed system with actual laboratory operational practices.

The second stage involved User Acceptance Testing (UAT), which was conducted qualitatively through direct user interaction with the system. During the evaluation sessions, participants assessed several operational aspects of the platform, including role-based accessibility, document upload and retrieval processes, workflow suitability, interface usability, activity logging, and notification functionality. The evaluation emphasized qualitative feedback and operational observations obtained during direct discussions and system demonstrations.

The integration of FGD and UAT enabled this study to gather comprehensive insights regarding both technical functionality and practical usability. This approach ensured that the developed system not only fulfilled functional requirements but also supported real operational activities within the laboratory environment.

Participant Selection Criteria

Participants in this study were selected purposively based on their direct involvement in daily laboratory operational activities and document management processes. This selection approach was adopted to ensure that the evaluation process involved users possessing

practical experience and comprehensive understanding of laboratory workflows.

The inclusion criteria consisted of:

- a) laboratory staff members actively involved in administrative and operational laboratory activities,
- b) users routinely handling laboratory documents and records,
- c) participants familiar with document management workflows,
- d) and individuals directly interacting with the developed system during operational activities.

Meanwhile, the exclusion criteria included:

- a) individuals not directly involved in laboratory document management activities,
- b) users without operational responsibilities related to document handling,

- c) and participants lacking practical experience regarding laboratory document workflows.

Based on these criteria, 15 participants were selected to participate in the Focus Group Discussion (FGD) and User Acceptance Testing (UAT) sessions. The purposive participant selection ensured that the evaluation feedback was obtained from users with relevant operational knowledge and practical experience related to laboratory document governance. All respondents voluntarily participated in this study and provided informed consent prior to their involvement in the data collection and evaluation processes.

System Design Methodology

The development of the TaKeDoLaSi system adopts the System Development Life Cycle (SDLC) methodology, as illustrated in Figure 1.

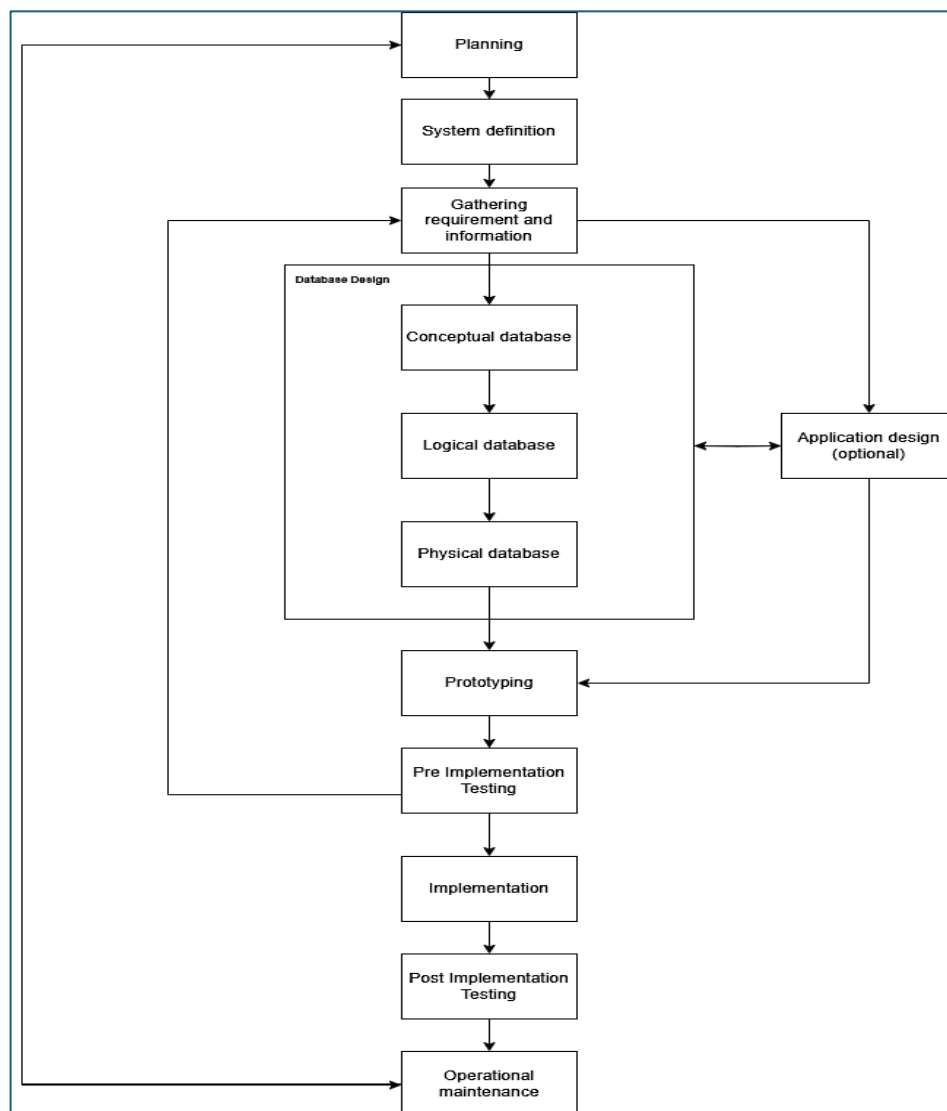


Figure 1: System Development Life Cycle

The planning stage focused on identifying the primary challenges associated with conventional laboratory document management, including inefficient retrieval processes, data redundancy, and limited access control mechanisms. Subsequently, the system definition stage established the scope and functional boundaries of the proposed platform. Requirement gathering and analysis were conducted through Focus Group Discussions (FGD) involving laboratory personnel directly engaged in operational document management activities. This phase identified both functional requirements, such as document upload, search functionality, activity logging, role management, and file categorization, as well as non-functional requirements including security, scalability, accessibility, and usability.

The database and system design stage involved conceptual, logical, and physical modeling processes to ensure data integrity and efficient system architecture. The Entity Relationship Diagram (ERD) was designed to define relationships among users, files, categories, tags, notifications, and activity logs. The system was developed using the Python programming language with the Flask framework, while SQLAlchemy was utilized as the Object Relational Mapping (ORM) technology for database management. Following the implementation phase, system evaluation was conducted through qualitative User Acceptance Testing (UAT) and Focus Group Discussions (FGD) involving 15

operational laboratory personnel. The evaluation process assessed system functionality, workflow compatibility, usability, accessibility, and the effectiveness of the Role-Based Access Control (RBAC) mechanism in supporting secure document governance.

The final stage involved operational maintenance activities, including performance monitoring, bug fixing, feature enhancement, and scalability planning to ensure long-term system sustainability and adaptability to organizational requirements. The implementation of the Waterfall SDLC model enabled the development process to proceed systematically while ensuring that each development stage was completed and validated before proceeding to the subsequent phase. This structured approach improved development transparency, reproducibility, and alignment with organizational governance objectives.

Results

After conducting rigorous testing and incorporating direct feedback from users, the system's requirements were further refined. This collaborative process led to the finalization of the conceptual database design, which centers on the identification of specific entity types and their interconnections. The foundational components of this architecture are detailed in the following sections: the entity types are outlined in Table 1, while the defined relationship types are presented in Table 2.

Table 1: Entity Type Identification

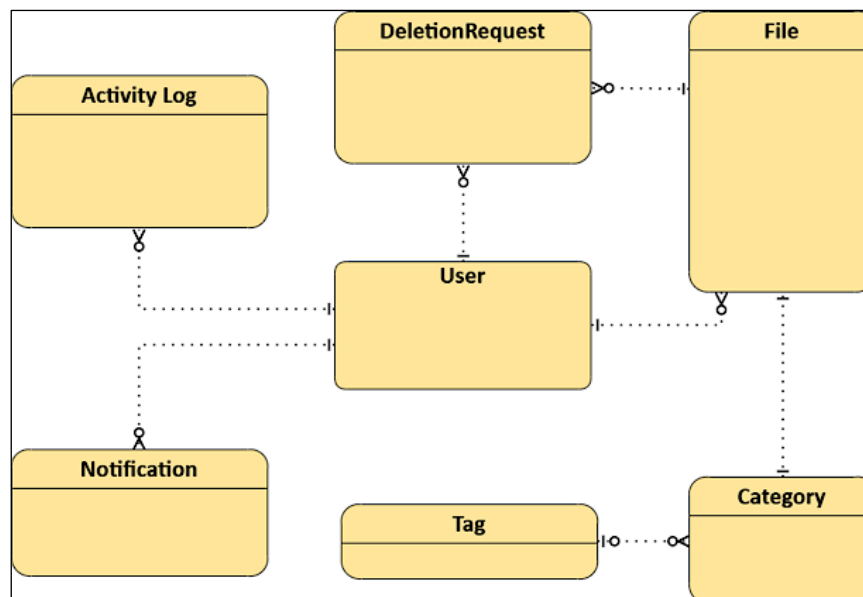
Entity Name	Description	Occurrence / Business Rule
User	Stores user account data, including email, username, password, role, and privileges.	Each user is assigned a role; each role possesses specific privileges.
File	Stores information on uploaded files, such as filename, path, type, size, upload date, category, tags, and user association.	Each file is assigned a single category but may contain multiple tags.
Category	Stores file category information, such as category name and description.	Each category can be associated with multiple files.
Tag	Stores additional labels/tags for file classification.	Each tag can be applied to multiple files.
Deletion Request	Stores file deletion requests, including reason, status, and decision comments.	Each request is initiated by a user regarding a specific file.
Notification	Stores notification messages for users, such as request status or system information.	Each user may receive multiple notifications.
Activity Log	Records user activity logs, such as login, upload, delete, or update actions.	Each log entry records a unique user activity at a specific timestamp.

Table 2: Relation Type

Entity	Multiplicity	Relationship	Multiplicity	Nama Entities
user	1..1	Owns	0..*	file
user	1..1	Submits	0..*	Deletion Request
user	1..1	Generates	0..*	Activity Log
user	1..1	Receives	0..*	notification
file	1..*	Belongs To	1..1	category
file	0..*	Has	0..*	tag
file	1..1	May Be Deleted By	0..*	Deletion Request
category	1..1	Groups	0..*	file
tag	1..1	Classifies	0..*	file

Building upon the conceptual database design phase, the resulting structure is illustrated in the Entity-Relationship Diagram presented in Figure 2 below. This visual representation serves as a foundational blueprint, bridging the initial requirements with the technical framework that follows.

Once the conceptualization for each entity has been established, the next logical step involves identifying the candidate keys and primary keys for every entity, as detailed in Table 3. This process is essential because the Primary Key serves as the fundamental unique identifier for an entity, ensuring data integrity across the system.

**Figure 2:** ERD Concep**Table 3:** Candidate and Primary Key Attributes

Entity Name	Candidate Key	Primary Key
User	email, password, username, user_role, user privilege	user_id
File	category_id, user_id, file_name, file_path, file_type, file_size, upload date, event_date, author_person_in_charge, additional_info, deletion_status, deletion_reason, attachment	file_id
Category	tag_id, name, description	category_id
Tag	name	tag_id
Activity Log	user_id, activity_type, timestamp, description	log_id
Notification	user_id, title, message, timestamp, status	notification_id

Deletion Request	file_id, user_id, request_date, reason, status, deletion_comment	request_id
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After establishing the Primary Keys for each entity, the process moves into the conceptual and logical database design phases. To bridge the gap between theoretical requirements and structural

implementation, these designs were meticulously developed to ensure data integrity and system scalability. The resulting conceptual and logical database frameworks are illustrated in Figure 3.

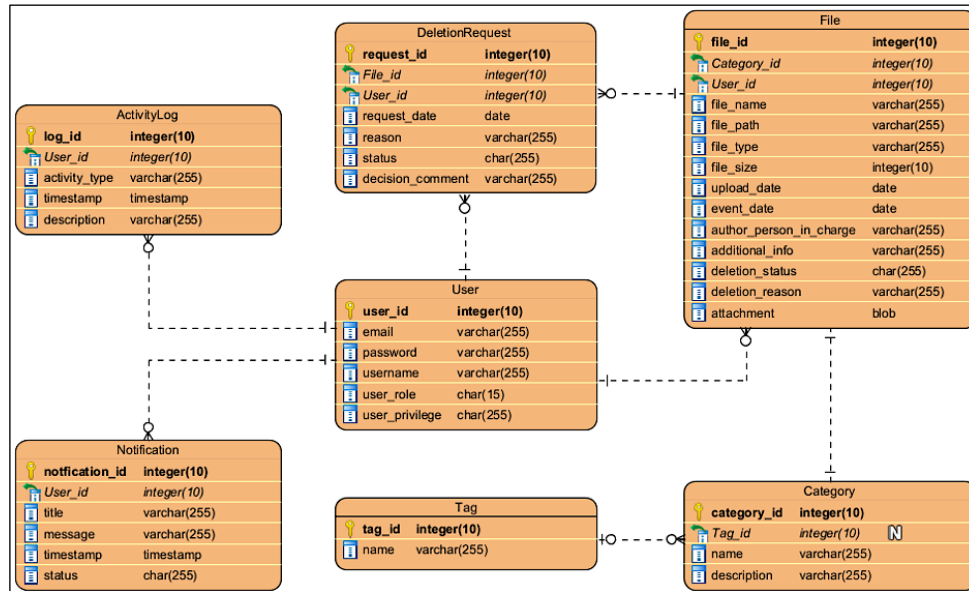


Figure 3: Physical ERD

Table 4: User Acceptance Evaluation Results Based on FGD

Scenario	Evaluation Focus	Expected Outcome	FGD Evaluation Result
Role-based login verification	Access restriction and authorization accuracy	Users can only access features according to assigned roles	Participants confirmed that the RBAC mechanism appropriately restricted access based on user roles and responsibilities
File upload capability	Upload usability and operational efficiency	Files can be uploaded successfully and accessed properly	Participants stated that the upload feature functioned effectively and supported daily document management activities
File deletion and editing capability	Administrative control and document management security	Files can only be modified or deleted by authorized roles	Participants agreed that the access control mechanism improved document security and administrative accountability
Tag and category management	Document classification and organization	Tags and categories can be managed according to user permissions	Users considered the classification features useful for improving document organization and retrieval efficiency
Role modification capability	User access management	User roles can be updated according to administrative authority	Participants confirmed that role modification features operated correctly and supported organizational workflow management
Activity log visibility	Monitoring and accountability	User activities are displayed according to access permissions	Participants reported that the activity log feature improved transparency and facilitated operational monitoring
Profile menu access	User interface accessibility	User profile information is displayed correctly	Users indicated that the profile interface was accessible and easy to navigate

Scenario	Evaluation Focus	Expected Outcome	FGD Evaluation Result
User account creation	Administrative usability	New user accounts can be created successfully	Participants confirmed that the account creation process functioned properly and supported administrative tasks
Notification system	Communication and system responsiveness	Notifications appear according to performed activities	Participants stated that the notification feature improved awareness of system activities and operational updates
Administrative login functionality	Role-specific accessibility	Admin and Superadmin accounts can access authorized features	Participants confirmed that administrative access permissions operated consistently according to assigned privileges
File download permissions	Access-controlled document retrieval	Files can be downloaded according to user permissions	Users reported that the document download process functioned effectively while maintaining access restrictions
File search functionality	Search efficiency and usability	Relevant files appear according to entered keywords	Participants considered the search feature useful for improving document retrieval speed and operational efficiency
User account freeze capability	User control and security management	Suspended accounts are restricted from performing activities	Participants confirmed that the account freeze feature strengthened administrative control and security management
Batch permission management	Permission management flexibility	Multiple user permissions can be updated simultaneously	Participants stated that the batch permission feature improved efficiency in managing large numbers of user accounts

The evaluation results indicate that the developed system successfully fulfilled its intended operational objectives. Participants reported positive responses regarding usability, workflow compatibility, accessibility, and security implementation. In particular, the Role-Based Access Control (RBAC) mechanism was considered effective in maintaining controlled access and improving organizational accountability. Furthermore, the document upload, retrieval, and classification features were regarded as efficient and aligned with daily laboratory operational requirements. Overall, the findings suggest that the proposed system achieved satisfactory user acceptance and practical usability for institutional document governance.

Discussion

Figure 2 illustrates the conceptual Entity Relationship Diagram (ERD) of the proposed TaKeDoLaSi laboratory document governance system, while Figure 3 presents the corresponding physical ERD implementation. Both figures collectively describe the relational database architecture designed to support secure document

management, role-based authorization, operational monitoring, notification handling, and structured document classification within the web-based platform. Conceptually, the ERD presented in Figure 2 illustrates the logical relationships among the primary operational entities involved in laboratory document governance processes, namely User, File, Category, Tag, Deletion Request, Activity Log, and Notification. These entities represent the core operational components required to manage document workflows, monitor user activities, maintain controlled access, and support administrative accountability within the proposed system.

As illustrated in Figures 2 and 3, the User entity functions as the central component connected to multiple operational entities, including File, Activity Log, Notification, and Deletion Request. This relational structure reflects the important role of users in managing document-related activities and supports the implementation of Role-Based Access Control (RBAC), where permissions are assigned according to operational responsibilities and access privileges. Controlled access mechanisms have been recognized as essential for

maintaining information integrity and organizational accountability in digital records management systems (11). Authorization control and traceability have also been identified as fundamental principles in records management governance (3).

In addition, the Deletion Request entity was specifically designed to strengthen governance and accountability mechanisms related to document deletion activities. Rather than permitting unrestricted file deletion, the system records deletion requests along with supporting information such as request dates, deletion reasons, approval status, and administrative comments. This mechanism improves procedural transparency and minimizes the risk of unauthorized document modification or removal. This logging mechanism enhances monitoring capability, auditability, and operational accountability by maintaining historical records of user interactions within the platform. Audit trails and log monitoring have been considered critical components for ensuring transparency, security, and accountability in cloud-based digital information systems (9, 20).

Furthermore, the Notification entity facilitates communication and workflow coordination by managing system-generated alerts and operational updates related to administrative activities and document management processes. This mechanism improves responsiveness and supports effective information dissemination among laboratory personnel. From a governance perspective, the integration of RBAC, activity logging, and controlled deletion procedures demonstrates that digital document management extends beyond simple electronic storage functionality. The proposed system operationalizes governance principles by embedding accountability, traceability, and authorization control directly into user interactions and document workflows. This indicates that effective digital archiving systems should be conceptualized not merely as repositories of information, but as governance infrastructures capable of supporting organizational compliance, operational transparency, and institutional accountability.

Furthermore, the integration of document classification, notification mechanisms, and operational monitoring contributes to workflow standardization and improves coordination among

laboratory personnel. These findings suggest that digital transformation within document governance involves not only technological change but also organizational restructuring, as administrative processes are converted into more controlled, transparent, and auditable workflows. Improvements in administrative efficiency and organizational performance through process standardization and enhanced information accessibility have also been reported in digital archiving systems (4, 5).

While Figure 2 focuses on the logical and conceptual relationships among entities, Figure 3 extends the model into its physical database implementation by defining detailed entity attributes, primary keys, foreign keys, and relational mappings required for actual system development. The physical database structure was designed to maintain referential integrity, database normalization, operational scalability, and secure access management processes. Scalability, operational flexibility, and centralized management have been identified as major advantages of cloud-supported document management systems (7, 8, 17). The integration of RBAC mechanisms, activity logging, notification management, and controlled deletion procedures contributes to the development of a secure, transparent, and sustainable digital governance framework for laboratory document management.

The User Acceptance Test (UAT) results, as presented in Table 4, confirm that every core function within the web-based document management system operates in full alignment with user requirements and expectations. This testing phase involved several scenarios representing critical system activities, including role-based login, file uploading and deletion, tag and category management, and profile and notification settings. Each scenario was meticulously designed to ensure optimal functionality for both admin and superadding roles, strictly adhering to their respective access levels.

The test results demonstrate a perfect match between expected and actual outcomes, with every scenario achieving a "Success" status. For instance, the login test confirmed that the system effectively restricts access based on assigned roles, while the upload and delete features executed seamlessly as intended. Furthermore, functions for managing tags, categories, and user activities operated

correctly within the boundaries of each role's permissions. Building upon these successful technical validations, it is evident that the system has achieved a high level of functional maturity. From the perspective of technology acceptance, the successful execution of core system functions demonstrates perceived usefulness and perceived ease of use, which have been recognized as primary determinants of user acceptance in information systems (18). Furthermore, system reliability and operational effectiveness have been shown to influence behavioural intention and organizational adoption in technology implementation environments (21). Usability, accessibility, and functionality have also been found to significantly influence user satisfaction and continued system usage in digital information systems and electronic library platforms (22–25).

Conclusion

This research was driven by the inherent limitations of conventional laboratory data management, which is often inefficient, prone to data loss, and fails to support organizational transparency and accountability. To address these challenges, the TaKeDoLaSi system (Information System for Laboratory Document Governance) was developed using the System Development Life Cycle (SDLC) approach. Furthermore, the study integrated the Technology Acceptance Model (TAM) to measure user adoption and Digital Transformation theory to evaluate the resulting shifts in business processes.

Building upon this developmental framework, rigorous testing through User Acceptance Tests (UAT) demonstrated that all core functions including document uploading and deletion, index-based searching, access control management, and activity logging performed in strict accordance with the established acceptance criteria. Every testing scenario achieved a “success” status, indicating that the system operates with consistency and stability. Complementing these technical results, Focus Group Discussions (FGD) revealed that active user involvement during the design phase significantly improved feature alignment, interface usability, and overall workflow refinement.

From a technical standpoint, the implementation of a semi-structured database proved effective in providing the flexibility needed to manage both

structured and unstructured data, allowing the system to adapt to various file types. Nevertheless, certain limitations remain, such as the absence of a multi-format file preview feature (for PDF, DOCX, JPEG, PNG, etc.) and restrictions on upload sizes due to the current Python-Flask and SQLAlchemy infrastructure.

Ultimately, the TaKeDoLaSi system has proven its capacity to enhance efficiency, security, and accountability in digital document management. The system is ready for implementation in a live operational environment and holds significant potential for future expansion through integration with centralized cloud storage and the addition of machine learning-based analytics to detect document usage patterns. Consequently, this research contributes to the development of web-based archiving models that are adaptive, participatory, and centered on user acceptance as the cornerstone of successful organizational digital transformation.

Limitations and Future Research

Despite the positive findings, this study has several limitations that should be acknowledged. First, the system evaluation was conducted within a limited laboratory operational environment involving only 15 participants. Consequently, the findings may not fully represent the broader implementation characteristics of document governance systems across larger or more diverse organizational contexts.

Second, the evaluation primarily focused on qualitative operational usability and user acceptance through Focus Group Discussions (FGD) and User Acceptance Testing (UAT). The study did not quantitatively measure long-term organizational performance indicators such as retrieval time reduction, productivity improvement, or cost efficiency after system implementation.

Third, although the developed system successfully integrates Role-Based Access Control (RBAC), activity logging, and governance-oriented document management mechanisms, the current infrastructure still has technical limitations, including restricted upload capacity and the absence of integrated multi-format document preview functionality.

Future research may expand the study by involving larger multi-institutional environments, implementing quantitative performance evaluation

models, and integrating advanced technologies such as cloud-native storage architecture, automated document classification, and machine learning-based document analytics. Further studies may also explore the long-term organizational impact of governance-oriented digital archiving on institutional transparency, compliance management, and operational sustainability.

Abbreviations

None.

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Author Contributions

All authors contributed to the research and design.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability

The data that supports the findings of this study are available from the corresponding authors, upon reasonable request.

Declaration of Artificial Intelligence (AI) Assistance

Authors used artificial intelligence tools to improve the readability and grammatical structure of the manuscript. After using this tool/service, the authors reviewed and edited the content as needed and took full responsibility for the content of the publication.

Ethics approval

Ethical review and approval were waived for this study due to the non-invasive nature of the survey, which involved professional opinions on technology usage and did not collect sensitive personal data. Informed consent was obtained from all subjects involved in the study.

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