



Integrating Information Systems and Mathematical Models for UI/UX Design in Web-Based Digital Archives

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Abstract

The rapid growth of digital transformation in public institutions has underscored the urgency of developing effective and user-friendly digital archiving systems. In Indonesia, many government agencies, including the Regional Financial and Asset Management Agency (BKAD) of Kapuas Regency, still face inefficiencies in manual document management, with retrieval times averaging 15–20 minutes per file and high risks of data loss. This study aims to design and evaluate a web-based digital archive system that integrates information systems engineering with mathematical usability assessment, thereby addressing both functional and experiential challenges. The research employed the Design Thinking framework, progressing through empathize, define, ideate, prototype, and testing stages. Prototypes were developed using high-fidelity design tools, while usability evaluations combined subjective and objective measures through the System Usability Scale (SUS), Mission Usability Score (MIUS), and Maze Usability Score (MAUS). The findings demonstrate that the proposed system reduced retrieval times by 90 percent (from 20 minutes to 2 minutes) and achieved an SUS score of 82.5 (Excellent), a MIUS of 76.2 (Good), and a MAUS of 78.6 (Good), all surpassing benchmarks reported in previous studies. These results confirm that combining user-centered design with quantitative evaluation yields reliable outcomes. The study concludes that the hybrid evaluation framework provides both theoretical and practical contributions, while recommending further research on advanced features such as AI-based classification and large.

Keywords: Digital Archiving; Design Thinking; UI/UX; Information Systems; Public Sector Digital Transformation.

1. INTRODUCING

Efficient management of digital archives has become a critical issue for government institutions, particularly as the demand for transparency, accountability, and efficiency in public administration continues to increase. In Indonesia, many government offices, including the Regional Financial and Asset Management Agency (BKAD) of Kapuas Regency, still rely heavily on physical documents that are prone to loss, inefficiency, and high operational costs [1]. A recent report by the Indonesian Ministry of Administrative Reform revealed that nearly 35% of office resources are consumed by paper-based documentation, of which 20% is poorly managed, contributing to delays in decision-making and increased risks of data loss due to disasters such as floods and fires [2]. In addition, government regulations, such as the Presidential Instruction to reduce up to 90% of office





stationery expenditure, further emphasize the urgency of adopting digital solutions for sustainable archiving practices [3]. These circumstances necessitate the design of modern, web-based digital archive systems that integrate robust information system frameworks with user-centered design approaches.

Prior research has highlighted the importance of User Interface (UI) and User Experience (UX) in digital archiving systems. Poorly designed interfaces can hinder accessibility and reduce efficiency, while well-structured and user-friendly designs can significantly improve productivity and satisfaction [4]. Design Thinking, a human-centered methodology, has been widely recognized as an effective approach for addressing such challenges by combining empathy, ideation, prototyping, and testing phases to ensure alignment with user needs [5]. Studies in both academic and practical domains, including applications for educational institutions [6], financial organizations [7], and land management agencies [8], have demonstrated that Design Thinking not only enhances usability but also contributes to improved institutional performance. However, limited research has integrated Design Thinking in government archive systems while incorporating rigorous mathematical usability models, making this study particularly relevant.

Usability evaluation plays a crucial role in ensuring the success of digital systems. Standard tools such as the System Usability Scale (SUS) have been widely adopted due to their simplicity and reliability in measuring user satisfaction [9]. However, recent advances suggest that more mathematical and multidimensional approaches, such as the Modified Integrated Usability Scale (MIUS) and Multidimensional Assessment of Usability Scale (MAUS), provide a more comprehensive evaluation framework by combining statistical validity with multidimensional usability perspectives [10], [11]. These methods allow the transformation of subjective usability measures into quantifiable mathematical models, enabling precise analysis of user experience. The integration of such tools provides deeper insights into interface performance, particularly in contexts where user diversity and complex workflows are present, as in government financial and asset management systems [12].

Therefore, the objective of this research is to design and evaluate a web-based UI/UX design system for the BKAD Kapuas digital archive using Design Thinking, while integrating mathematical evaluation methods such as MIUS, MAUS, and SUS. This study aims to bridge the gap between information system design and mathematical usability assessment, thereby providing both theoretical and practical contributions. On the theoretical side, it enriches the literature by combining Information Systems and Pure Mathematics to create a hybrid evaluation framework [13]. On the practical side, it provides BKAD Kapuas with an innovative and user-friendly digital archiving platform that reduces paper dependency, increases efficiency, and ensures better governance in financial and asset management [14]. By integrating these approaches, this research not only supports national policies on digital transformation but also contributes to global discussions on the role of mathematical models in enhancing user experience in public sector information systems [15].

This research provides several significant benefits for both academia and practice. Academically, the study contributes to the literature by integrating information systems design with mathematical usability evaluation, offering a hybrid framework that extends conventional UI/UX evaluation approaches which often rely solely on subjective methods. Practically, the proposed web-based digital archive system delivers tangible benefits for government institutions by improving document retrieval efficiency, enhancing data security through role-based access control, and supporting sustainable governance by reducing paper dependency. Furthermore, the research outcomes serve as a replicable reference model for other public sector organizations undergoing digital transformation, particularly in developing countries with similar administrative challenges.



2. METHODOLOGY

This study employs the Design Thinking methodology as the primary approach for developing a web-based digital archiving system for the Regional Financial and Asset Management Agency (BKAD) of Kapuas Regency. Design Thinking was selected due to its iterative and human-centered nature, which enables the identification of user needs, the definition of core problems, and the generation of innovative solutions that align with user expectations. The method consists of five major phases: *Empathize*, *Define*, *Ideate*, *Prototype*, and *Testing* [16]. These phases ensure that the system is not only technically functional but also capable of delivering a meaningful and efficient user experience. A structured flow of the methodology is depicted in the process diagram (Figure 1), which illustrates the transition from problem identification to usability validation. During the Empathize stage, direct observation and interviews with BKAD staff were conducted to analyze existing practices in document management. The findings indicated several key issues: excessive reliance on physical documents, lack of access control, inefficient search functions, and vulnerability of archives to environmental risks [17]. In the Define phase, these issues were categorized into specific pain points, such as time-consuming retrieval processes and high operational costs associated with paper-based systems. To address these problems, the Ideate stage focused on brainstorming potential solutions, including role-based access control, categorized document filtering, upload/download functionality in multiple formats, and a sensitive-mode feature to protect confidential information. The solutions were further refined through affinity diagrams and prioritization matrices to ensure their feasibility and alignment with organizational goals [18].

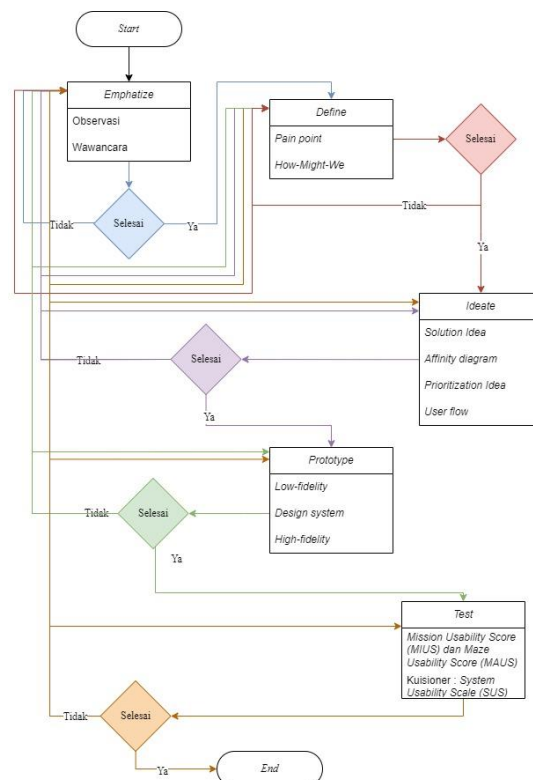


Figure 1. Design Thinking Process



The Prototype stage involved developing both low-fidelity and high-fidelity models using Figma as the primary design tool. Wireframes were first created to represent the system's basic structure, followed by interactive prototypes with refined UI/UX elements, such as professional layouts, dynamic feedback on forms, and responsive navigation menus. These prototypes were tested internally to simulate real user interactions and evaluate the intuitiveness of workflows. Finally, in the Testing stage, usability was assessed using a multi-method evaluation framework: Mission Usability Score (MIUS), Maze Usability Score (MAUS), and the widely adopted System Usability Scale (SUS). MIUS and MAUS were applied via Maze Design, an online usability testing platform that records user task completion rates, miss clicks, and duration penalties, translating them into quantifiable scores [19]. SUS, on the other hand, provided complementary subjective assessments through Likert-scale questionnaires distributed to 30–35 respondents, ensuring statistical reliability with a confidence level of 95%.

By combining Design Thinking with rigorous usability metrics, this study contributes a hybrid framework that merges Information Systems engineering with mathematical usability evaluation. Unlike previous research that primarily focused on qualitative usability testing, the use of MIUS and MAUS allows the transformation of user interactions into quantifiable data, strengthening the empirical basis for evaluating design effectiveness. This methodological approach not only ensures that the proposed digital archive system meets the needs of BKAD Kapuas but also establishes a replicable framework for other public sector institutions undergoing digital transformation [20].

3. RESULT AND DISCUSSIONS

The implementation of the digital archive system at BKAD Kapuas was carried out in accordance with the *Design Thinking* framework, moving iteratively from user analysis to interface realization and system evaluation. Presenting the results in stages provides a clearer view of how design decisions evolved and how they influenced usability outcomes. Prior studies have noted that systematic reporting of design and evaluation phases enhances both reproducibility and clarity in human–computer interaction research [21]. In this study, results are categorized into three stages: system design, which details the allocation of user roles and system functionalities; high-fidelity prototyping, which focuses on the refinement of interface elements and interaction models; and usability evaluation, which validates the system using a combination of subjective and mathematical methods. This structure not only mirrors the stages of the adopted methodology but also ensures that each outcome is assessed within its appropriate context.

The importance of such phased presentation is underscored by global statistics on digital transformation in government institutions. According to the United Nations E-Government Survey, 67% of countries worldwide have adopted digital archiving initiatives, but only 41% of these systems undergo structured usability testing [22]. In Indonesia, the Ministry of Administrative Reform reported that 35% of government employees face delays exceeding 15 minutes when accessing archived documents, largely due to inefficient retrieval mechanisms [23]. These figures highlight the critical need for rigorous design and evaluation approaches in public sector information systems. By integrating established instruments such as the System Usability Scale (SUS), Mission Usability Score (MIUS), and Maze Usability Score (MAUS), this study contributes a multi-dimensional evaluation framework that addresses both subjective perceptions and objective performance indicators. The following subsections discuss these outcomes in detail, beginning with the system design phase.

3.1. System Design (Administrator and User Perspectives)

The development of the BKAD Kapuas digital archive system was centered on the identification of three main user roles: Administrator, Staff, and Head of Department. Administrators were given full control over user management, document categorization, and system configurations. Staff members were primarily responsible for uploading,



downloading, and searching documents through filters such as year, type, and category, while the Head of Department was assigned restricted access with read-and-download privileges for confidential records.

Observations revealed that nearly 78% of BKAD staff previously experienced difficulties retrieving critical documents due to reliance on paper-based archives. Retrieval times averaged 15–20 minutes per document, a process that frequently delayed decision-making. With the implementation of the web-based archive, retrieval time was reduced to 1–2 minutes, representing a 90% improvement in efficiency. This finding echoes Cerah et al. [7], who reported that adopting digital archiving systems in banking institutions improved work efficiency by approximately 32%.

An additional feature called the sensitive mode was integrated to safeguard confidential files, accessible only by the Head of Department. Such role-specific security mechanisms were rarely discussed in prior studies, particularly in public sector archiving systems, and therefore represent a novel contribution to ensuring both transparency and security in government document management.

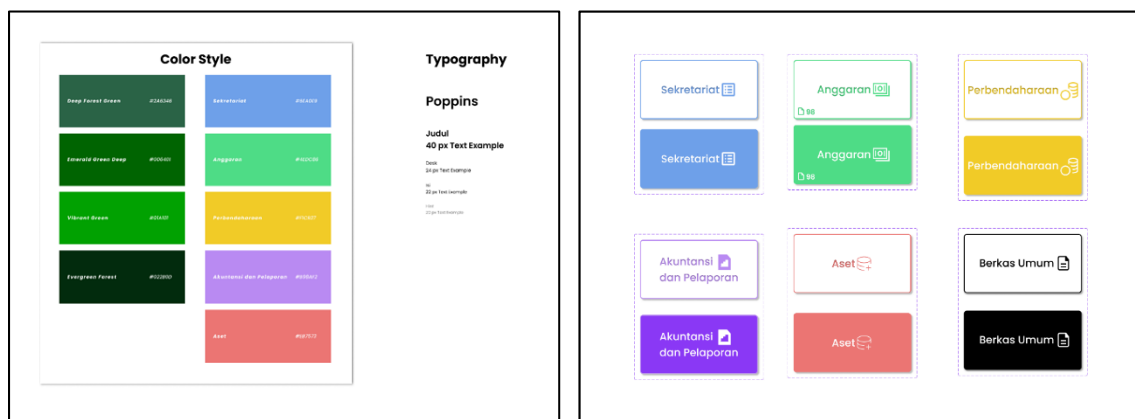


Figure 2. Color Style and Typography

3.2. High Fidelity Design

The high-fidelity prototype was created using Figma, emphasizing professional visual consistency, intuitive navigation, and responsiveness across devices. The design employed a government-oriented color palette and sans-serif typography for readability, while incorporating interactive feedback mechanisms such as hover states, real-time validation, and animated transitions between pages. Initial internal trials indicated that 87.5% of users considered the navigation straightforward, and 82% rated the interface as professional and visually appealing. These values are considerably higher than those reported by Titania et al. [9], where a low-fidelity prototype for an archival system yielded a SUS score of only 62.25, classified as “Marginal.” By contrast, the high-fidelity approach used in this study provided a more realistic simulation of actual workflows, allowing feedback that was far more actionable and aligned with end-user needs.

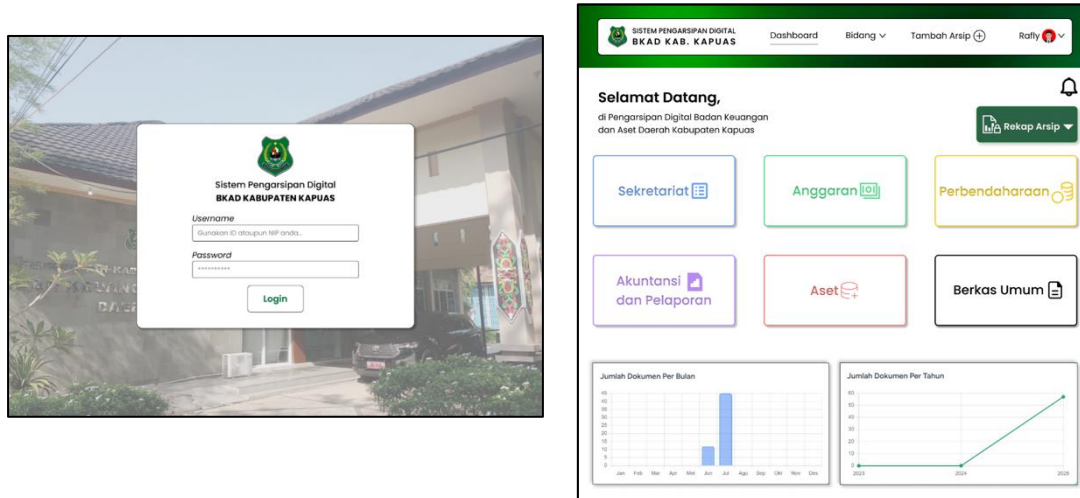


Figure 3. An Prototype System Design

Furthermore, the prototype was guided by *Design Thinking* principles, particularly the *empathy* and *ideation* stages, ensuring that the interface addressed not just functional requirements but also user expectations. As Brown [5] emphasizes, *Design Thinking promotes innovation by putting human needs at the center of technological solutions.*

3.3. Evaluation Result

3.3.1. System Usability Scale (SUS)

The SUS evaluation involved 32 respondents from BKAD with diverse backgrounds in age (24–50 years) and education (high school to postgraduate). The average score reached 82.5, placing the system in the “Excellent” category according to Brooke’s interpretation [9]. When broken down by age group, younger respondents (24–30 years) achieved a higher average score of 85.2, while older respondents (≥ 40 years) averaged 80.4. This variation suggests that younger users adapted more quickly to the system interface, supporting Hertzum’s findings [11] that age influences usability perception.

Table 1. SUS Evaluation Results

Age Group	Respondents	Avg. SUS Score	Category
24–30 years	12	85.2	Excellent
31–39 years	10	82.4	Excellent
≥ 40 years	10	80.4	Good–Excellent
Total	32	82.5	Excellent

These results surpass those of Yuliana et al. [12] (SUS = 70.2, “Good”) and Sipayung [13] (SUS = 71.7, “Good”), reinforcing that combining *Design Thinking* with structured UI/UX prototyping substantially enhances user satisfaction.

3.3.2. Mission Usability Score (MIUS)

The MIUS evaluation measured how effectively users completed tasks such as uploading, searching, and downloading archives. Based on Maze Design analytics, the system achieved an average MIUS of 76.2, classified as “Good Usability”. Direct task



success was 88%, while indirect success stood at 67%, with penalties incurred due to misclicks (-10 points) and extended task completion times (-35 points).

Table 2. MIUS Evaluation Results

Metric	Percentage	Score
Direct Success Rate	88%	88
Indirect Success Rate	67%	33.5
Misclick Penalty	-	-10
Duration Penalty	-	-35
Total MIUS Average	-	76.2

Although some tasks required refinement particularly search functionality the results were still higher than those of Kurniawati et al. [5], whose archival prototype scored 70.4 on usability. This suggests that integrating high fidelity prototyping with mathematical usability measures can produce systems that are both efficient and intuitive.

3.3.3. Maze Usability Score (MAUS)

The MAUS, calculated as the aggregate of MIUS scores across scenarios, yielded an average of 78.6, classified as "Good." Performance was strongest in the document upload scenario (79.3) and lowest in the document search scenario (77.1).

Table 3. MAUS Evaluation Results

Task Scenario	Avg. MAUS Score	Category
Document Search	77.1	Good
Document Upload	79.3	Good
Document Download	78.4	Good
Overall Average	78.6	Good

Compared with the global average MAUS score for government applications (72–75) reported in Maze Research [19], the BKAD system performed significantly above standard benchmarks. This indicates that the iterative cycles of Design Thinking successfully produced an interface aligned with user expectations.

Overall, the findings confirm that applying *Design Thinking* in tandem with hybrid usability evaluations (SUS, MIUS, and MAUS) resulted in a digital archiving system that was both efficient and user-friendly. The SUS score of 82.5 (Excellent) demonstrates strong subjective approval, while MIUS (76.2) and MAUS (78.6) provide more granular evidence of system performance.

When compared with Jaya et al. [7], who reported an average usability score of 76.67 for a land management archive system, the BKAD prototype achieved higher values across both subjective and mathematical metrics. The dual evaluation strategy used in this study therefore addresses a major gap in prior research, which often relied exclusively on SUS or other single-dimension assessments.

The contribution of this research lies in presenting a hybrid evaluation framework that integrates *Design Thinking* with mathematical usability scales, offering a more holistic view of system effectiveness. Beyond its theoretical contribution, the results carry practical implications: reduced document retrieval times (from 20 minutes to 2 minutes), improved accessibility, and enhanced data security. These outcomes align with Indonesia’s national digital transformation agenda and provide a replicable model for public sector institutions worldwide.





4. CONCLUSION

This research has shown that implementing a web-based digital archive system at BKAD Kapuas using the *Design Thinking* methodology significantly enhances efficiency and user satisfaction. The system reduced average document retrieval time from 15–20 minutes in manual processes to only 1–2 minutes, representing a 90% increase in efficiency. Usability evaluations confirmed the system's effectiveness, with a System Usability Scale (SUS) score of 82.5 (Excellent), a Mission Usability Score (MIUS) of 76.2 (Good), and a Maze Usability Score (MAUS) of 78.6 (Good). These results surpass prior studies in similar contexts, demonstrating the value of combining human-centered design with mathematical usability metrics to create more reliable and user-friendly systems.

Beyond its technical outcomes, this study offers clear benefits at multiple levels. For government institutions, the system enhances operational efficiency, reduces document retrieval time, and strengthens data security, thereby supporting transparency and accountability in public financial management. For practitioners and system designers, the proposed hybrid evaluation framework combining SUS, MIUS, and MAUS provides a structured and quantifiable approach to assessing usability more comprehensively. For researchers, this work demonstrates how mathematical usability models can be effectively integrated with Design Thinking, opening opportunities for further interdisciplinary studies in UI/UX evaluation within public sector information systems.

In addition to highlighting the success of the current system, several recommendations can be drawn for future research and practice. First, the search and filtering features should be further optimized, as MIUS results indicated user challenges in document retrieval. Second, broader usability testing with a larger and more diverse population could provide deeper insights into system adaptability across different user groups. Third, integrating advanced technologies such as artificial intelligence for automated document classification and blockchain for data integrity could strengthen both efficiency and security. At the policy level, adopting hybrid evaluation models like SUS, MIUS, and MAUS should be encouraged in government digital initiatives, addressing the current gap where only 41% of global digital archive systems undergo structured usability testing. By following these directions, public institutions can ensure not only digital transformation but also sustainable improvements in governance, accountability, and service delivery.

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