Ministry of Science and Higher Education of the Republic of Kazakhstan
SDU University

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Research and analysis document management system at the university

THESIS
Presented in Partial Fulfilment for the

Degree of Master of Technical Science in Computer Science
(degree code: 7M06102)
Department of Computer Science
Faculty of Engineering and Natural Sciences

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Kaskelen, June 2024

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« 04 » 06 2024

Topic of the thesis:

Research and analysis document management system at the university

Thesis submitted as part of the requirements for the award of the MSc in "7M06102 - Computer Science", SDU University

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Declaration

I confirm that this is my own work and the use of all material from other sources has been properly and fully acknowledged.

Shynar Toktar

June 2024

Acknowledgements

Dear Committee,

I would like to express my deepest gratitude to my supervisor, Professor Lyazzat Atymtayeva, for her support, guidance and feedback throughout the process of researching and writing this dissertation. Her experience, advice and support have played an important role in shaping the direction of my research and improving my analytical skills.

I am grateful to my mother for her support, love and understanding throughout my academic career. Their support was motivating.

I would also like to express my gratitude to the Director of the Automation Department, Elvin Naghiyev, for providing the data that allowed me to obtain a master's degree and conduct this research.

Finally, I would like to express my gratitude to all my friends and colleagues who provided moral support, meaningful discussions and assistance when needed.

Thank you for attention.

Dedication

This thesis is dedicated to:
SDU University and the BPM team.

Abstract

In today's IT landscape, the selection and implementation of Document Management Systems (DMS) are vital for improving decision-making and automating various workflows. DMS enables efficient document storage and access through digitization and automation, significantly reducing the time and costs associated with manual document management. For DMS to function optimally and meet user needs, intuitive user interfaces(UI) are essential. Despite the critical role of DMS in IT infrastructure, comprehensive analyses of this software are rare. This thesis addresses this gap by providing a detailed, real-world analysis of a university's DMS and its impact on business processes. Through advanced database analysis, the study identifies key issues such as user accessibility, and retrieval inefficiencies. The research offers practical solutions, including structured workflows, standardized processes. The findings emphasize the importance of user-centric design, continuous training, and support structures to enhance user interaction and system efficiency. This work not only optimizes the university's document management but also offers a framework adaptable to various organizational contexts, ensuring compliance with regulatory standards and improving overall information management practices.
Keywords: Document Management Systems (DMS), workflow efficiency, automation, universities, software.

Аңдатпа

Бүгінгі IT саласында құжатты басқару жүйелерін (DMS) таңдау және енгізу шешімдер қабылдауды оңтайландыру және әртүрлі жұмыс процестерін автоматтандыру үшін өте маңызды. DMS цифрландыру және автоматтандыру арқылы құжаттарды тиімді сақтауға және қол жеткізуге мүмкіндік береді, құжатты қолмен басқаруға байланысты уақыт пен шығындарды айтарлықтай азайтады. DMS оңтайлы жұмыс істеуі және пайдаланушы қажеттіліктерін қанағаттандыруы үшін интуитивті пайдаланушы интерфейстері (UI) маңызды. IT-саласындағы DMS маңызды рөліне қарамастан, бұл бағдарламалық жасақтаманың жан-жақты талдаулары аз. Бұл дипломдық жұмыс университеттің DMS және оның бизнес-процестерге әсерін егжей-тегжейлі, нақты талдауды қамтамасыз ету арқылы жетіспеушіліктерді қарастырады. Жетілдірілген дерекқорды талдау арқылы зерттеу пайдаланушының қол жетімділігі, іздеудің тиімсіздігі сияқты негізгі мәселелерді анықтайды. Зерттеу құрылымдық жұмыс процестерін, стандартталған процестерді қамтитын практикалық шешімдерді ұсынады. Нәтижелер жүйе тиімділігін арттыру үшін пайдаланушыға бағытталған дизайнның, үздіксіз оқытудың және қолдау құрылымдарының маңыздылығын атап көрсетеді. Бұл жұмыс университеттің құжат айналымын оңтайландырып қана қоймайды, сонымен қатар әртүрлі ұйымдық контексттерге бейімделетін, нормативтік стандарттарға сәйкестікті қамтамасыз ететін және жалпы ақпаратты басқару тәжірибесін жетілдіретін құрылымды ұсынады.

Түйін сөздер: Құжат Айналымы Жүйелері, жұмыс процесінің тиімділігі, автоматтандыру, университеттер.

Аннотация

В сегодняшней ИТ-среде выбор и внедрение систем управления документами (DMS) имеют решающее значение для оптимизации принятия решений и автоматизации различных рабочих процессов. DMS обеспечивает эффективное хранение документов и доступ к ним посредством оцифровки и автоматизации, что значительно сокращает время и затраты, связанные с ручным управлением документами. Для оптимального функционирования DMS и удовлетворения потребностей пользователей необходимы интуитивно понятные пользовательские интерфейсы (UI). Несмотря на решающую роль DMS в ИТ-инфраструктуре, всесторонний анализ этого программного обеспечения недостаточен. Данная диссертация устраняет этот пробел, предоставляя подробный анализ реальной ситуации в университетской СУД и ее влияние на бизнес-процессы. Благодаря расширенному анализу базы данных исследование выявляет ключевые проблемы, такие как доступность для пользователей и неэффективность поиска. Исследование предлагает практические решения, включая структурированные рабочие процессы и стандартизированные процессы. Результаты подчеркивают важность ориентированного на пользователя дизайна, непрерывного обучения и структур поддержки для улучшения взаимодействия с пользователем и эффективности системы. Эта работа не только оптимизирует управление документами в университете, но и предлагает структуру, адаптируемую к различным организационным контекстам, обеспечивая соответствие нормативным стандартам и улучшая общие методы управления информацией.

Ключевые слова: системы документооборота, эффективность документооборота, автоматизация, университеты, программное обеспечение.

Abbreviations

DMS - Document management system
BPM - Business Process Management
IEC - International Electrotechnical Commission
ISO - International Organisation for Standardisation
IEEE - The Institute of Electrical and Electronics Engineers

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Chapter 1

Introduction

Universities are increasingly depending on digital infrastructure to manage the significant rise of academic and administrative papers in the constantly evolving higher education sphere. The Document Management System (DMS), as the focal point of this transition, acts as the foundation for organizing, storing, and retrieving vital information.

Efficient document management is more than a convenience for colleges, it is a strategic need. According to an article published in the International Journal of Educational Policy Research and Review, good document management is positively related to organizational efficiency and as a result, academic excellence. The article highlights that, with a growing emphasis on collaborative research, interdisciplinary studies, and globalization of higher education, institutions are being forced to improve their document management procedures to remain competitive and fulfill the expectations of the modern academic environment [1]. Moreover, by using DMS across different sectors, such as organizations, government agencies, local governments, and universities, has been demonstrated to lower operational expenses, boost operational efficiency, and enhance cooperation among stakeholders [2].

As reported by Johnston and Bowen [3], the implementation of DMS leads to improved information governance and better compliance with regulatory requirements. These systems facilitate faster retrieval and secure storage of documents, reducing operational costs and enhancing collaboration among stakeholders. Furthermore, DMS can integrate seamlessly with existing processes, providing clear, quantifiable benefits and a positive return on investment by streamlining document-related workflows and improving overall productivity.

Despite the recognized importance of DMS, there is a noticeable lack of comprehensive analysis focusing on their performance and impact, particularly within educational institutions. This thesis aims to address this gap by providing detailed, high-quality, and reliable information based on a data analysis of a university's DMS and its associated business processes.

This paper presents a detailed examination and analysis of the university's Document Management System, using insights from the university's DMS processes and database to propose methods for improving it. Additionally, it compares the university's DMS with other enterprise solutions and evaluates its alignment

with global standards to prevent other organizations and enterprises from building poorly implemented document management systems.

Furthermore, data analytics will be employed to analyze the performance of the DMS's business processes. By leveraging data analytics techniques, the study will identify trends, detect anomalies, and provide insights into the efficiency of document-related workflows. This analytical approach will help uncover areas for improvement, optimize the system's functionality, and enhance the overall user experience.

Additionally, a survey was carried out to get feedback from university employees about the effectiveness and usefulness of the present DMS. To highlight opportunities for user interface and user experience enhancement, a comprehensive study of the DMS forms was also carried out.

In conclusion, this thesis seeks to contribute to the field of document management in higher education by providing actionable insights and practical recommendations for the development and enhancement of DMS. The findings are expected to benefit not only the case study university but also other educational institutions looking to optimize their document management systems.

1.1 Statement of the problem

Several problem statements highlight the challenges faced by organizations in implementing and optimizing DMS:

- There are no clear rules or principles that establish uniform requirements for the documentation of management activities.
- The volume of management information that needs to be tracked and maintained by the organizations is increasing.
- There are large and small processes that respectively have two or more stages that can be analyzed and optimized.
- There are no researches that analyze internal processes in detail.

This thesis seeks to address several critical challenges in document management. First, it explores how to establish uniform requirements for the documentation of management activities. By standardizing these requirements, organizations can ensure consistency and compliance across various departments. Additionally, the study investigates the most effective ways to manage the increasing volume of management information. As the amount of information grows, efficient strategies are essential to maintain organization and accessibility. Finally, the thesis examines methods to improve workflow by reducing the number of steps in each process. Simplifying processes and expanding user feedback can significantly enhance efficiency and user satisfaction within the system.

1.2 Methodology overview

To achieve our goal, several key tasks must be accomplished:

1. Analysis of bibliography related to DMS development: Conduct a thorough review of existing literature and research on the development of DMS.

2. Data collection: Gather relevant data from the university's database to provide a solid foundation for analysis.

3. Data analysis: Analyze the collected data to identify anomalies and evaluate the performance of business processes and workflow steps.

4. Suggesting solutions: Propose actionable solutions based on the findings from the data analysis to improve the efficiency and effectiveness of the DMS.

The main methods of our research are comparative and operation cycle analysis, methods for visualizing our data, data analysis, and exploratory factor analysis methods for evaluating the factors that can affect the process of developing and monitoring standards.

1.3 Thesis outline

The theoretical and practical significance of the study lies in identifying the factors influencing the operation of the process and providing high-quality and reliable information in the form of recommendations for developers of standards.

The structure of this study consists of 4 chapters. The first chapter is devoted to a review of the literature. The research of other authors in the field of standardization is considered here.

The next chapter covers the part describing general information about the workflow and the structure of the business process.

The third chapter presents the methodological part, where we examined the methods that will be used in our research.

The last chapter presents the analysis and results of our research conducted using methodologies such as standards and document management review, process flow analysis, process form analysis and thematic analysis.

Chapter 2

Literature review

There is a limited amount of literature and research available on the topic of the development and analysis of DMS. This section will review previous studies conducted by different authors.

According to the book called Business Process Management maturity models are used to examine document management systems processes performance and management [4]. Maturity models offer direction on evaluating the current status of development and maintenance processes through evaluating them across various levels and components [5].

Concisely, the maturity model is a tool that provides ways of finding the problems in the system without giving information on how to fix them. There are generally five maturity models such as QMMG, CMM, CMMI, OMG BPMN and PEMM [6]. Each of them has their own advantages and drawbacks. For the study, the two most common assessment approaches to assessing process maturity were reviewed which are CMMI and PEMM. The Capability Maturity Model Integration (CMMI) is an approach to process maturity that can be used to evaluate processes. This model could be used as the base for the discussion when assessing the maturity of specific processes or the enterprise as a whole [7]. The Process Enterprise Maturity Model (PEMM) was developed as a tool to help organizations that are planning to move to processes. This model includes one framework to rate business processes and enterprise maturity level [7]. Process prerequisites include the following: scheme, indicators, performers, owner, and infrastructure.

By integrating these models into my research, I systematically evaluated the current status of document management processes, identified key areas for improvement, and developed strategies to enhance efficiency and effectiveness. This structured approach allowed me to gain valuable insights into the maturity and performance of our university's document management system, providing a solid foundation for ongoing development and optimization.

Article [8] introduced a framework for an automated information system designed to manage quality assurance in higher education institutions. The system aims to automate tasks associated with quality assurance, helping stakeholders handle and monitor their activities effectively. The proposed system includes a core module and 17 sub-modules, which facilitate various aspects of quality management, such as educational process effectiveness, strategic planning, and institu-

tional capacity. This comprehensive approach ensures that quality standards are maintained and enhanced throughout the institution.

The field of Document Management Systems has seen significant advancements in user interface (UI) and user experience (UX) design, aimed at improving efficiency, security, and user satisfaction. A comprehensive case study by Southtech [9] highlighted the importance of redesigning the UI of DMS to streamline document approval processes and enhance user productivity. The study involved extensive user research, including building personas, sketching, and wireframing, which culminated in a prototype focusing on an intuitive document approval workflow. Key improvements included better team collaboration features, a simplified interface, and enhanced productivity through automation.

The thesis [10] provides valuable insights into the development and optimization of Document Management Systems (DMS) with a focus on user interface (UI) and user experience (UX). This work is highly relevant for understanding the effective management of document workflows in organizations and highlights the importance of UI/UX in the adoption and efficiency of these systems.

In the paper, author discusses the integration of several DMS tools such as Microsoft SharePoint, Socialcast, and DocStore, emphasizing their unique features and suitability for different document management needs. SharePoint, for instance, is praised for its comprehensive capabilities in document and content management, including version control, integration with Microsoft Office, and robust search functionalities. These features enhance user experience by making documents easy to locate, manage, and collaborate on, thus reducing the reliance on email for document sharing and discussions. It also highlights the role of Socialcast in improving real-time communication and collaboration among team members. By integrating Socialcast with SharePoint, Nokia Gear was able to create a more cohesive and interactive environment, where feedback and updates could be shared promptly, further enhancing user engagement and reducing email clutter. This integration showcases the importance of choosing tools that not only meet technical requirements but also improve the overall user experience by fostering better communication and collaboration.

DocStore is another system discussed in the thesis, particularly for its capabilities in handling highly confidential documents and providing automated property and security inheritance. This system's focus on security and ease of use ensures that sensitive documents are protected while being easily accessible to authorized users, which is crucial for maintaining data integrity and compliance [10].

The user interface and user experience aspects are crucial in ensuring the successful adoption of these systems. Thesis underscores the need for a user-friendly interface that simplifies the process of saving, searching, and retrieving documents. Training and ongoing support are essential to help users navigate new systems and adapt to changes, thereby ensuring that the DMS is used to its full potential.

Moreover, the paper outlines the challenges of current document management practices, such as the lack of standardization and overlapping systems, and provides solutions for improving these practices. By implementing structured workflows, setting clear categorization and folder structures, and ensuring seamless integration with existing tools, organizations can streamline their document man-

agement processes, reduce manual errors, and improve productivity [10].

Similar work [11] emphasizes the importance of user interface (UI) and user experience (UX) in the development of University Management Information Systems (UMIS). The authors noticed that the ease of performing tasks such as course registration and school fee payment is crucial for user satisfaction. The study employed User-Centered Design (UCD) processes and system design thinking methodology to address usability issues. Questionnaires were used to gather user pain points, which informed the design of a more usable interface. User personas and wireframes helped visualize the data from user research, and Figma was used for prototype and interface design. Usability testing showed a high System Usability Scale (SUS) score of 87, indicating that users found the system easy to navigate and engaging.

The paper [12] explores the impact of the General Data Protection Regulation (GDPR) on DMS development. The study focused on developing a GDPR-compliant software solution for managing job applications in the human resources department. The authors emphasized the importance of consent, data security, and user rights enforcement. They highlighted the need for a system that includes functionalities like user authentication, data encryption, pseudonymization, and detailed logging to ensure compliance with GDPR. The implementation of these features in a DMS enhances data protection and provides users with greater control over their personal data.

The approach detailed by [13] shows the importance of integrating documentation workflows with software development processes, which can be directly applied to the design and implementation of effective DMS. By adopting such integrated frameworks, organizations can ensure that their documentation is not only complete and accurate but also aligned with the software's evolving functionalities and user requirements.

Furthermore, the unified process proposed by Priestley and Utt offers a strategic advantage by promoting continuous documentation updates throughout the software development lifecycle. This continuous integration helps in maintaining the relevance of documentation, as it evolves in parallel with the software. Such a process reduces the risk of outdated or mismatched documentation, which is a common issue in traditional, siloed documentation practices. By embedding documentation activities into each phase of software development, from inception to deployment, organizations can achieve higher efficiency and coherence between the software and its user manuals.

In addition, integrating documentation development with software workflows fosters better collaboration between technical writers and software developers. This synergy not only enhances the quality of the documentation but also ensures that user manuals are more user-centric, addressing real-world user needs more effectively. The unified process allows technical writers to participate in reviews and iterations, offering a unique perspective that focuses on usability and clarity. Consequently, this approach can lead to more intuitive and user-friendly documentation, ultimately improving the overall user experience and satisfaction with the software product.

The article provides an in-depth examination of workflow management systems

(WFMS), highlighting their pivotal role in automating and facilitating business processes. Workflow systems are categorized into three primary types: transaction, administrative, and ad hoc workflows. Transaction workflows are repetitive and highly structured, suitable for processes like loan and insurance claims processing, which benefit from automation and strict controls. Administrative workflows, such as handling holiday requests or travel claims, typically rely on email for routing forms and may include advanced features like form creation and deadlines. Ad hoc workflows are more flexible and cater to dynamic projects, such as marketing or new product development, where steps cannot be predefined. Workflow management systems enhance efficiency by presenting documents to workers only when their input is required, exemplifying push technology. This approach minimizes the need for active information retrieval by workers, thereby improving overall productivity. The article underscores the necessity of integrating documents into business processes, advocating for the use of intelligent agents to automatically deliver relevant information, thus addressing the challenges of information overload and worker finiteness [14].

To gain a deeper understanding of the coding backend part of the University Document Management System (DMS), the "eBA Coding Reference Guide." was studied. This guide provides comprehensive information on the development and customization of the eBA Workflow Management System, a tool widely used for creating and managing document workflows in educational institutions. The guide covers essential topics such as form interface-based coding, which includes instructions on designing and coding forms using the eBAControls. eBABaseForm class, detailing properties, methods, and events related to various form controls. It also provides insights into validation and event handling, crucial for ensuring data integrity and user interaction within the forms. Furthermore, the guide elaborates on workflow interface coding, offering detailed guidance on coding workflows, managing the flow of documents through different stages, handling user interactions, and automating processes within the DMS. Additionally, it includes instructions on integrating and utilizing external libraries within the eBA platform, essential for extending the functionality of the DMS and integrating it with other systems. The Form Data API section explains the eBAForm class and its properties and methods, enabling developers to interact programmatically with form data, perform CRUD operations, and manage data efficiently. Comprehensive details on using eBA libraries and APIs for advanced functionalities, including workflow management, document handling, and data synchronization, are also covered, which are critical for implementing custom solutions and enhancing the capabilities of the DMS. Lastly, the guide offers guidelines for creating and integrating custom controls into the eBA system, allowing for tailored solutions that meet specific institutional requirements. By reading this guide, it was possible to grasp the technical intricacies involved in developing and maintaining a backend system for a University DMS, which has been instrumental in designing efficient, user-friendly, and secure document management workflows tailored to the needs of higher education institutions [15].

In conclusion, the literature underscores the importance of a structured, user-centric approach to DMS development and optimization. By leveraging maturity

models, advanced UI/UX design principles, robust security measures, and integrated documentation workflows, organizations can significantly enhance the efficiency, usability, and compliance of their document management systems. This holistic approach not only improves organizational productivity but also ensures that DMS solutions meet the evolving needs of users and regulatory standards. Furthermore, it fosters a culture of continuous improvement, where feedback from users drives ongoing enhancements to the system. This continuous loop of assessment and optimization helps maintain the relevance and effectiveness of the DMS. Ultimately, embracing these comprehensive strategies can lead to more intuitive, secure, and user-friendly document management solutions that support both operational goals and regulatory requirements. These studies provide a comprehensive approach to DMS development, ensuring that organizations can manage their documents efficiently while maintaining high standards of data integrity and user satisfaction.

Chapter 3

Structure of DMS

3.1 Fundamentals of DMS

A Document Management System (DMS) is a software solution designed to manage, store, and track electronic documents and images of paper-based information through digitization [16]. It provides a centralized repository for document storage, enabling efficient retrieval, enhanced security, and improved collaboration among users. DMS solutions offer functionalities such as version control, access control, audit trails, and document indexing, which help in maintaining document integrity and compliance with regulatory requirements.

A DMS encompasses several core functions designed to streamline document handling and management. These core functions include:

- **Document Storage:** The primary function of a DMS is to store documents in a centralized repository. Documents are stored in a digital format, making them easily accessible and reducing the need for physical storage space.
- **Document Indexing:** Indexing involves assigning unique identifiers to documents to facilitate quick retrieval. This is typically done using metadata, which includes information such as document type, author, creation date, and keywords.
- **Document Retrieval:** A robust search capability allows users to quickly locate documents using various search criteria such as keywords, metadata, and full-text search. Advanced retrieval options may include Boolean searches and proximity searches.
- **Document Security:** Security measures are essential to protect sensitive information. A DMS provides access control features that allow administrators to set permissions for different users or user groups, ensuring that only authorized individuals can access or modify certain documents.
- **Version Control:** Version control tracks changes made to documents over time, allowing users to view and revert to previous versions if necessary. This is crucial for maintaining the integrity and accuracy of documents.
- **Workflow Management:** Workflow management automates the flow of documents through predefined processes. This can include document approval, review, and distribution, ensuring that documents move efficiently through their lifecycle.

The main responsibility of a DMS is to be user friendly and make it possible to easily access information. Also it makes long-term document preservation possible and facilitates the easy flow of papers within the company. DMS solutions may often be categorized into four primary types [1]:

1. Basic document management system (DMS) - small businesses usually have it. These solutions are easy to use, and while some may have rudimentary protection measures, their main purpose is file sharing. However, they are not appropriate for more complicated document management needs since they lack additional functionality like audit trails, certification and signature capabilities, and deep historical insights.
2. Commercial DMS solutions - are primarily employed by businesses with extensive documentation needs. These solutions offer enhanced document control and more sophisticated document access capabilities.
3. Archival DMS solutions - are frequently used to store articles at universities and huge libraries. Although editing is not possible with this method, searching and reading articles is undoubtedly much easier.
4. Enterprise DMS solutions - the most advanced and are primarily utilized by large corporations. These solutions incorporate multiple repositories that integrate with a company's systems to create extensive databases. [17]

The process of transition to new automated technologies is often associated with obvious difficulties related with the complexity of introducing electronic document management systems into the daily activities of organizations. In this regard, a critical examination of existing methods and real projects for introducing automated technologies into the field of document management seems very relevant. When implementing an DMS at an enterprise, the following goals are set:

- minimization or complete elimination of paper document flow;
- development of a unified company information base;
- reducing the risk of document loss;
- structuring of all documentation according to the approved nomenclature;
- control over the execution of documents. [18]

The use of an electronic document management system can significantly improve the material and technical base of educational institutions and encourages teaching staff to take courses to improve computer literacy. This, in turn, makes it possible to introduce computer electronic document management systems into the management process of an educational institution, which help quickly process information. And to make a management decision, there is often a lack of timely, complete and reliable information. Therefore, to improve management efficiency, it is necessary to use an electronic document management system.

The application of an automated information and analytical system in the management of an educational institution contributes to:

- increasing the efficiency of the decision-making and planning process based on obtaining reliable information in real time about the state of the educational process;
- freeing the school administration from unproductive routine work of collecting and processing information and increasing the time for carrying out the

direct analytical function of school management;
- significant reduction in management reaction time (decision making, task setting, execution control);

3.1.1 DMS in Higher Education Institutions

University DMS (Document Management Systems) differ significantly from those utilized in other enterprises due to their focus on student services and academic processes. While traditional DMS in businesses prioritize document storage and retrieval for operational efficiency, university DMS encompass a broader scope, incorporating functionalities tailored to the unique needs of educational institutions. These systems not only manage administrative documents but also facilitate student record management, academic program coordination, and collaborative research efforts. Consequently, university DMS play a pivotal role in enhancing the overall academic experience by streamlining processes, ensuring compliance with regulatory standards, and fostering seamless communication among faculty, staff, and students.

The research by Ridei et al [19] highlights several key issues in document management within higher education institutions:

1. **Archaic Systems:** The current system contains outdated principles and excessive bureaucratization inherited from the Soviet era, leading to inefficiencies and delays in document processing.
2. **Centralization and Bureaucratization:** Strict centralization and a rigid hierarchy often politicize the document creation process, turning management decisions into documents that reflect political will rather than administrative efficiency.
3. **Duplication and Manual Entry:** There is a significant issue with the duplication of electronic documents on paper and the lack of automated mechanisms for data entry, which increases the workload for educators and administrative staff.
4. **Security Concerns:** The implementation of digital document management systems (DEMS) faces security challenges, particularly concerning the safe transfer and storage of official information.

3.1.2 Comparison of existing DMS

In Kazakhstan, the enactment of the law on electronic signatures [20] significantly advanced the development of electronic document management systems (EDMS). In this context, it is critical to review and analyze the DMS systems that are widely utilized in Kazakhstan. The table below (Table 3.1) gives a comparative study of these systems' essential features and functionalities, highlighting their respective strengths and limitations.

University that was analyzed for case study uses the eBA system. eBA is highly versatile, offering a wide range of functionalities including archiving, user group properties, delegation, notifications, mobile applications, document reporting, and the ability to implement additional configurations. It also supports programming

Table 3.1 – Comparison of DMS features

Name of DMS	**eBA**	**Lotus Notes**	**Documentolog**
Archive	yes	yes	yes
User group properties	yes	no	no
Delegation	yes	yes	no
Notification	yes	no	no
Mobile Application	yes	no	yes
Report of documents	yes	no	yes
Implement any other configurations	yes	yes	yes
Programming	C#	no	SaaS
Corporate calendar	no	yes	yes

using C#. However, it lacks a corporate calendar feature.

Lotus Notes supports archiving, delegation, and has a corporate calendar, but it falls short in several areas. It does not support user group properties, notifications, mobile applications, or document reporting. Additionally, it does not support programming configurations.

Documentolog, like eBA, offers archiving, mobile applications, document reporting, and the ability to implement additional configurations. It uses SaaS for programming. However, it lacks support for user group properties, delegation, and notifications. It includes a corporate calendar feature.

Overall, eBA provides the most comprehensive set of functionalities, while Lotus Notes and Documentolog have more specialized features with certain limitations. Each system has unique strengths, making them suitable for different organizational needs.

3.2 Fundamentals of business process

A business process in the context of a Document Management System (DMS) refers to the systematic series of steps or activities that organizations follow to achieve a specific goal related to document handling and management. These processes typically include the creation, review, approval, distribution, storage, retrieval, and disposal of documents. By leveraging a DMS, businesses can automate and streamline these workflows, ensuring consistency, efficiency, and compliance with regulatory requirements.

There are different approaches to dividing the process of implementing an EDMS into stages and substages. Most often, when switching to electronic document management, an approach is used that involves division into several stages: pre-project, design, post-project [6]. The pre-design stage is one of the most important stages in the implementation of an EDMS, as it includes the formulation of the problem. The main component of this stage is the awareness of the need for transformation.

3.2.1 Main business processes involved in the DMS

A business process can be characterized as a systematic arrangement of activities or tasks designed to accomplish a specific business objective or goal. Business processes have four main types:

1. Governance processes, which oversee the functioning of the organization. These include corporate governance and strategic management.
2. Operational processes, which are the primary activities of the organization and directly contribute to its core functions.
3. Supporting processes, which provide assistance to the core business operations. Examples include accounting, recruiting, and technical support.
4. Academic processes, which pertain to activities related to academic functions within an educational institution. This includes processes such as student applications and academic work management [21].

3.2.2 Process development and life cycle

The Figure 3.1 depicts a process flow chart with six sequential steps involved in the creation of a business process. Here's a detailed description of each step:

1. **Define Objective and Scope**:
   - This initial step involves setting clear goals and boundaries for the project. It is crucial to understand what needs to be achieved and to delineate the limits within which the project will operate.
2. **Draw up a Diagram**:
   - In this step, a visual representation of the process is created. Diagrams such as flowcharts or process maps help in visualizing the workflow and identifying key components and interactions within the process.
3. **Details of Stages, Roles, and Responsibilities**:
   - This stage involves outlining the specific phases of the process, assigning roles, and defining responsibilities for each stage. Clear documentation of these details ensures that every team member understands their tasks and the overall process flow.
4. **Development**:
   - The actual development phase where the process is built according to the defined objectives, scope, and detailed plans. This step involves the creation and implementation of the necessary components and procedures.
5. **Test**:
   - Once the process is developed, it needs to be thoroughly tested to ensure it functions as intended. This step involves identifying and resolving any issues or bugs before the process goes live.
6. **Production**:
   - The final step where the developed and tested process is deployed into the production environment. At this stage, the process becomes fully operational and is used in real-world scenarios.

Each arrow in the diagram represents a step in the process, with the flow moving from defining objectives to full-scale production, ensuring a systematic

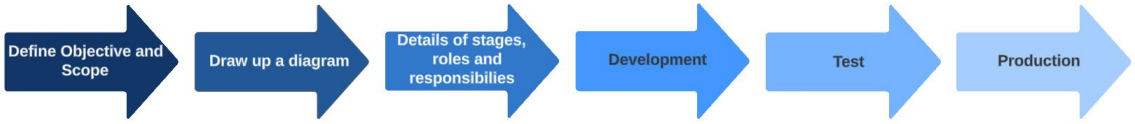

Figure 3.1 – Business process creation steps

and structured approach to business process creation.

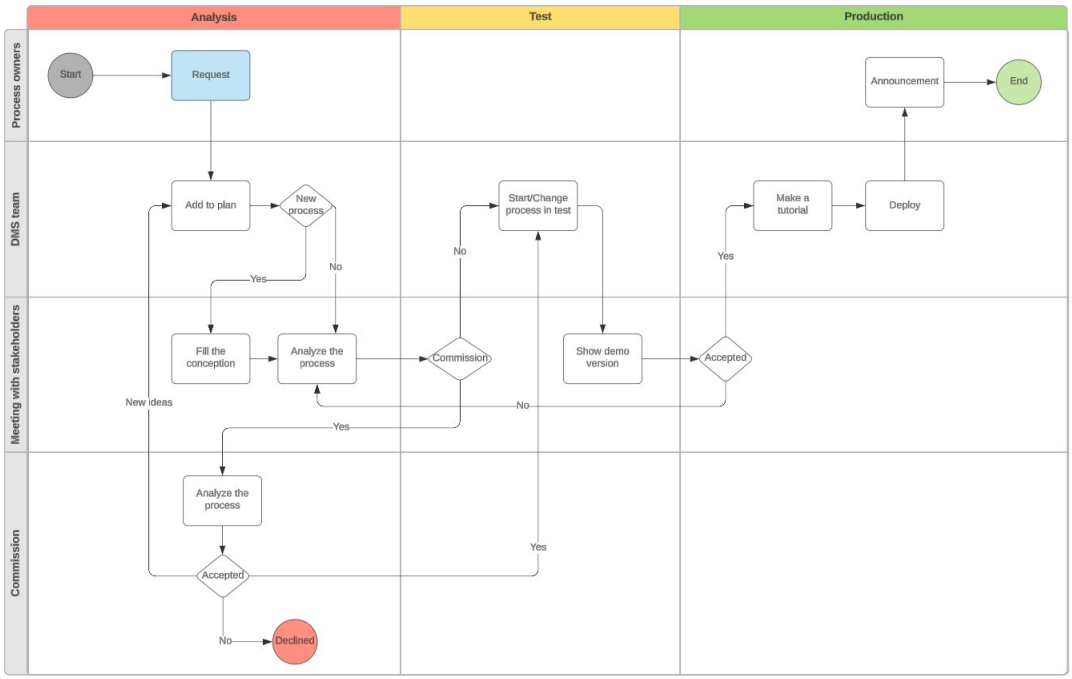

Figure 3.2 – Life cycle of process development

The life cycle of process development in the university, as depicted in the provided process flowchart(Figure 3.2), is divided into three main stages: Analysis, Test, and Production. It begins with the Process Owners initiating a request, which the DMS Team adds to their planning schedule. A decision is made to determine if the request is for a new or existing process. If it's a new process, it moves forward, while modifications might be required for existing ones. The DMS Team then fills out the conception, outlining objectives, requirements, and expected outcomes, and analyzes the process to ensure feasibility and alignment with university standards. Regular stakeholder meetings are held to review and incorporate feedback into the process design. If accepted, it progresses to the Commission for evaluation. Accepted processes enter the testing phase, where a demo version is created and reviewed by stakeholders. Upon acceptance, the DMS Team creates a tutorial to guide users, followed by the deployment and official announcement of the new or modified process. The life cycle concludes with successful deployment or a decline if the process fails at any stage. This structured and iterative approach ensures high standards and alignment with the university's

goals and requirements.

3.2.3 Form and flow

Flow Management System is a process development platform that enables quickly transferring work processes to electronic automation and integration with other corporate applications as well as increasing profitability of enterprises and extending process oriented work concept. We need workflow systems for standardizing, optimizing, fastening and automation of corporate processes. Such systems make smart documents and forms and enable management of those on electronic environment.

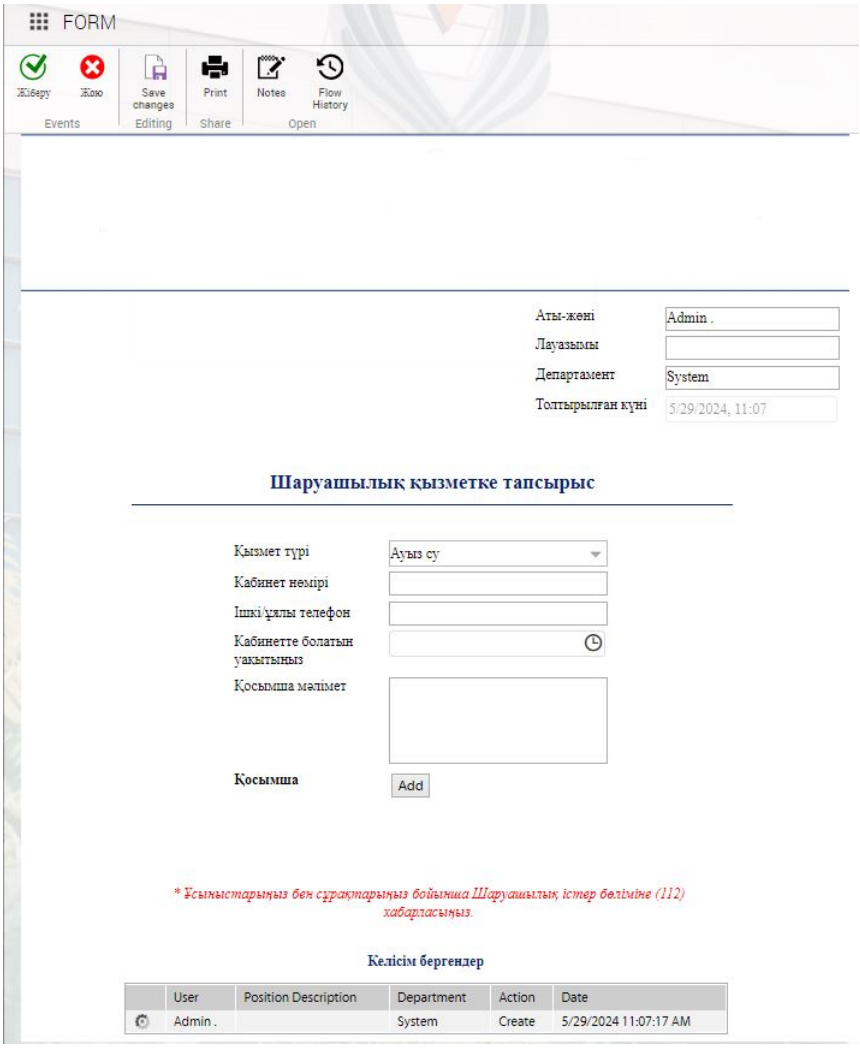

Figure 3.3 – DMS form

Utilizing forms enables the creation of index information for documents, thereby facilitating rapid access and the generation of reports based on this indexed information. A form in a DMS is crucial for streamlining administrative processes within an organization. These forms typically move through various stages of review, approval, and storage, making the workflow efficient and organized. In a

DMS, the workflow can be either sequential or parallel. Sequential workflows involve step-by-step approval, while parallel workflows allow multiple approvers to review the document simultaneously. By using such systems, organizations can automate and streamline document-related tasks, ensuring that documents move efficiently through the necessary steps with proper access, control, and governance. For example, once a form is submitted, it is automatically routed to the appropriate personnel for review and approval, enhancing productivity and reducing the chances of errors.

Administrative labor involves handling processes including holiday requests and travel claims. Typically, e-mail is used for correct form routing. Advanced features may include form generation, deadlines, and notifications. Workfow products track employees' deliverables, presenting documents only when necessary. This is an example of push technology, where information is automatically delivered to the user without their active action.

This is an example of a form that users must fill out for a specific administrative process (see Figure 3.3). As can be seen, the top bar includes options to send or delete the form. If the form is sent, it will follow a flow within the document management system, ensuring proper processing and tracking.

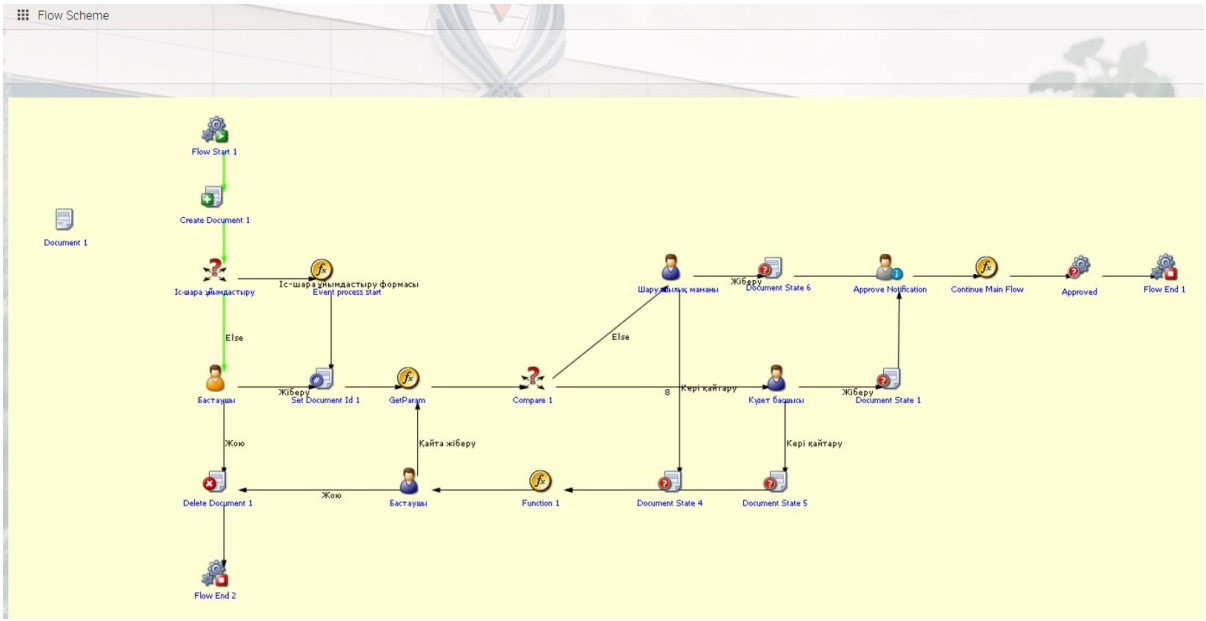

Figure 3.4 – Workflow of the process

Figure 3.4 illustrates the comprehensive architecture of the workflow at the university. This form pass through DMS workflow. This workflow diagram represents a document management process involving multiple roles and decision points. The process starts with "Flow Start 1," followed by the creation of two documents ("Create Document 1") and a function ("Function 2"). The process involves various states such as "Document State 1," "Document State 2," and so on, each indicating different stages in the document's lifecycle. Key roles involved include the initiator, department manager, and the head specialist. The workflow includes several assignments (e.g., "Assignment 1," "Assignment 3") where tasks are dele-

gated to different personnel. Decision points like "Compare 1" and "Or Operator 2" determine the next steps based on certain conditions. The process also includes document deletion ("Delete Document 1") and approval steps ("Approved"). The workflow concludes with notifications back to the initiator, indicating whether the agreement was approved or not. Each transition between states is marked by green lines, representing the flow of documents through the system.

3.3 Current trends in Document Management System

The field of Document Management Systems (DMS) has evolved significantly over the past decade, driven by advancements in technology and the increasing need for efficient management of digital documents. This section explores the current trends and challenges in DMS, providing a comprehensive overview based on recent studies and industry reports. Trends in Document Management Systems

1. **Cloud-Based Solutions**: One of the most significant trends in DMS is the shift towards cloud-based solutions. Cloud-based DMS offers numerous advantages, including scalability, cost-efficiency, and remote access. This trend is supported by a study from MarketsandMarkets, which predicts that the cloud-based DMS market will grow from USD 3.1 billion in 2021 to USD 11.3 billion by 2026 [22]. The adoption of cloud technology allows organizations to manage their documents more flexibly and efficiently, enabling real-time collaboration and seamless integration with other cloud services.
2. **Artificial Intelligence and Machine Learning**: The integration of AI and machine learning into DMS is revolutionizing the way documents are managed and processed. AI-powered DMS can automate repetitive tasks, such as data entry and document classification, thereby improving accuracy and reducing human error. According to a report by Gartner, AI will be a mainstream element in 75% of DMS solutions by 2025 [23]. Machine learning algorithms can also enhance document search capabilities, making it easier to retrieve relevant information quickly.
3. **Mobile Access and Remote Work**: The rise of remote work has highlighted the importance of mobile access to DMS. Modern DMS platforms are increasingly offering robust mobile applications that allow users to access and manage documents from their smartphones and tablets. This trend is essential for maintaining productivity in a remote or hybrid work environment. A survey by Statista indicates that 60% of organizations have adopted mobile DMS to support their remote workforce [24].
4. **Enhanced Security Features**: As cyber threats become more sophisticated, the need for enhanced security in DMS has become paramount. Current DMS solutions are incorporating advanced security features such as encryption, multi-factor authentication to ensure the integrity and confidentiality of documents. The Ponemon Institute reports that organizations are increasingly prioritizing security in their DMS investments, with 68% of firms citing data security as a critical factor in their DMS selection [25].

Chapter 4

Methodology

This section discusses the research methods used in this study, with an emphasis on tools and functional requirements.

4.1 Research model

The purpose of this study is to analyze the shape and form of the process. Flow analysis is an analysis of efficiency and identification of bottlenecks in the Document management System (DMS) at the university. The methodology includes several data analysis methods to understand user behavior, identify anomalies, and optimize processes. Our approach to analyzing document forms is based on well-established principles of user interface (UI) and user interaction (UX) design, as well as documentation standards.

In order to analyze DMS of local university the following actions can be implemented:

1. Data Collection: Data collection: Data collection was carried out using two methods. The first is from the database, Collecting relevant data from the university's document management database to analyze the flow of the document. The second method is a questionnaire. The questionnaire was used to collect data from university staff about process problems.
2. Process Flow Analysis: Evaluating how much time each process consumes, highlighting areas of inefficiency. Investigating the underlying causes contributing to significant time consumption or inefficiencies in the system.
3. Process Form Analysis: Evaluation of the form of the process based on the principles of user interface (UI) design, user interaction (UX) and documentation standards.
4. Solutions and Recommendations: Proposing actionable solutions based on the analysis to optimize the efficiency of the DMS.

This following sections will describe this steps.

4.2 Data collection

To perform a preliminary data analysis and obtain the results of the analysis, several steps must be performed. In this study, the proposed data analysis and visualization begins with the collection of data, which consists of information from the DMS database. After the data set is collected, the data is preprocessed. Finally, data analysis is performed using visualization.

A systematic method of obtaining the results of observations or measurements is known as data collection. Data collection helps you gain first-hand experience and unique information about your research task, whether you are conducting research for industry, government, or academia. In our case, we collected data for the analysis of DMS. Data can be collected using various methods and procedures. The data was collected using an SQL query. SQL queries are necessary to work with information from the database. This can be insertion, extraction, sorting, deletion and a number of other operations. Data for this study was collected from the DMS database of the local university. The data has been extracted for the last 2 years. April 2022 - April 2024. In total, 60 processes are actively used in the DMS. To optimize the flow process, you need flow data. Ensuring data anonymity is crucial for maintaining the confidentiality and privacy of individual users, preventing their identification. This research will adhere to data security standards. The rules of ethics were observed when collecting data. For the safety of users, columns with the personal information of users have been excluded.

Secondly, data preprocessing is performed after data collection. It is a method of converting unstructured, complex data into systematized, understandable information. The entire data set was checked for missing values. All duplicate columns are deleted. Duplicate columns that appeared after the tables were merged, such as the process name, process status, document ID, and others, were removed. Several columns are added for analysis, for example, the duration of each stage and the type of process. As a result, the data set becomes more consistent.

The data is taken from 4 tables. DocumentData, FlowData, ProcessData and Users.

The first set of DocumentData stores information about the documents transferred to the DMS system. The set contains information about the process: The name of the process, the number of the process, the status of the document finished/ not finished, the version of the document, the creator of the document.

The second set of ProcessData contains more summary information than the FlowData table, presents information, information about each stage in a single row. The set contains the start and end dates of each stage, the status deleted/not deleted, the status.

The third set of FlowData stores the values of our approval requests. Who has this process, what steps it went through and when. The name of the object, the date of the request, the date of the response, the reason for the refusal (if refused), the stage number, the stage status.

The fourth set of users contains information about the names of the department.

Every dataset consists of different row numbers and column numbers such as the following:

1. First set: 83636 rows × 11 columns
2. Second set: 51429 row × 14 columns
3. Third set: 404138 rows × 15 columns
4. Fourth set: 1436 rows × 4 columns

To begin, it is advisable to explain the concept of a business process. A business process can be characterized as a systematic arrangement of activities or tasks designed to accomplish a specific business objective or goal. Business processes may have four main types [21]:

1. Governance processes, which oversee the functioning of the organization. These include corporate governance and strategic management processes, such as proposal, syrtkykhat.
2. Operational processes, which are the primary activities of the organization and directly contribute to its core functions. This includes student application submissions and student service processes, such as medcer, academalys.
3. Supporting processes, which provide assistance to the core business operations. Examples include accounting (avans), recruiting (workcertif), and technical support(techreq).
4. Academic processes, which pertain to activities related to academic functions within an educational institution. This includes academic work management processes, such as teacher plan, office hour.

4.3 Thematic analysis of the survey

Quantitative analysis and research were conducted using questionnaires to collect data on the problems of using processes. In order to find problems and confirm that we are working on the right path, we have distributed a questionnaire to the university staff. The survey was created on the Google Forms platform, and links to the surveys were distributed via work email. The survey was anonymous. The questionnaire contained closed and open questions, these open questions allow respondents to speak properly and in more detail, proving the greater reliability of the data used. The data collected through the questionnaire allows us to assess the various problems faced by university staff. First of all, information about users was set in the questionnaire. The staff answered questions related to the type of position, age range and work experience in recent years. Then the respondents were asked to answer questions about these groups: using the system and technical support. Each group has elements related to the next group. Table 4.1 below shows the questions answered by the staff.

In total, the university staff needs to evaluate 11 factors. To evaluate the factors that will help improve the quality of the system, we used several types of response. The answers were suggested: Yes/No, choose between 1 = No, 2 = Low, 3 = Medium, 4 = High and 5 = Very High, text response. Based on the results of the survey, a thematic analysis was conducted, the results of which will be described in the following sections.

Table 4.1 – Questions evaluated by local university staff

Category	Question	Sample Answers
BPM Usage	BPM Usage Frequency?	• Daily • Once a week • Rarely
	Convenience of Start Process?	• Convenient • Not convenient • Not convenient
	Convenience of My Processes?	
	Convenience of Reports?	
	Convenience of Dashboard?	
	Convenience of Document Archive?	
	Do you know where the approval scheme is?	• Yes • No
	Do you track the launched process?	
	How clear is the approval scheme?	1-5
Feedback	Which processes take long to get a response?	Text answer
	Which processes cause difficulties?	
	Comments or suggestions for BPM improvement?	

4.4 Standards for DMS

My work is focused on creating uniform requirements and optimizing the Document Management System (DMS) at our institution. To achieve this, we have conducted a thorough review of relevant DMS standards and compiled a comprehensive list of best practices and functional requirements.

The International Organization for Standardization has adopted the following definition: "A standard is a normative document developed on the basis of consensus, approved by a recognized body, aimed at achieving an optimal degree of order in a certain area." [26]

In accordance with the Law of the Republic of Kazakhstan "On Standardization", a standard is a document developed on the basis of the consent of interested parties, which establishes rules, general principles, or characteristics for general and repeated use, relating to various types of activities or their results [27].

Standards for Document Management Systems (DMS) provide detailed guidelines and best practices to ensure efficient, secure, and compliant handling of documents and records. The key standards organizations relevant to DMS are ISO (International Organization for Standardization), IEC (International Electrotech-

nical Commission), and IEEE (Institute of Electrical and Electronics Engineers). These standards encompass critical areas such as records management, information security, quality management, business continuity, and configuration management, offering a comprehensive framework to assist organizations in achieving their objectives and maintaining excellent documentation practices.

The following list 4.2 details these practices and their corresponding standards. Each item is briefly explained, followed by a more in-depth discussion on process improvement.

Table 4.2 – List of functional requirements

№	**Functional Requirement**	**Standards References**	**Brief Explanation**
1	Uniform Requirements for DMS	ISO 30300:2020, ISO 30301:2019	These standards provide the foundational principles and requirements for establishing a uniform records management system, ensuring consistency and efficiency across the organization.
2	Document Classification	ISO 15489-1:2016	Document classification involves categorizing records systematically to improve retrieval and management, aligning with ISO 15489-1 guidelines.
3	Naming Conventions	ISO 15489-1:2016	Standardized naming conventions enhance organization and searchability of documents, facilitating easier access and management.
4	Access Control	ISO/IEC 27001:2013, ISO 15489-1:2016	Implementing access control measures ensures that only authorized personnel can access or modify documents, thus safeguarding sensitive information.
5	Version Control	ISO 15489-1:2016, IEEE 828-2012	Version control tracks document changes and maintains a history of versions, preventing confusion and ensuring the accuracy of records.
6	Document Lifecycle Management	ISO 15489-1:2016, ISO 30301:2019	Managing the stages a document goes through from creation to disposal ensures proper handling and timely archiving or destruction of records.
7	Audit Trails	ISO 15489-1:2016, ISO/IEC 27001:2013	Audit trails record all actions performed on documents, providing accountability and facilitating compliance with regulatory requirements.
8	Backup and Recovery	ISO/IEC 27031:2011, ISO 22301:2019	Regular backups and a robust recovery plan ensure the protection and restoration of documents in case of data loss.

9	Integration Requirements	ISO 30300	Effective DMS integration with other systems enhances interoperability and efficiency, allowing seamless workflows across different platforms.
10	Compliance and Legal Requirements	ISO 15489-1:2016, ISO 9001:2015	Adhering to compliance and legal requirements ensures that the DMS meets all regulatory standards and industry best practices.
11	User Training and Support	ISO 9001:2015	Providing adequate training and support enables users to effectively utilize the DMS, enhancing overall system efficiency and user satisfaction.

The implementation of these best practices and standards is crucial for the optimization of the DMS. Each aspect, from document classification to user training, contributes to a more organized, secure, and efficient management system. The integration of these practices ensures that documents are systematically categorized, easily retrievable, and securely managed throughout their lifecycle.

Process improvement involves a continuous cycle of assessing current practices, identifying areas for enhancement, and implementing changes based on the standards mentioned. For instance, introducing robust version control and audit trails enhances transparency and accountability, while comprehensive user training programs ensure that all personnel are proficient in using the DMS effectively.

In the next section, we will focus on each of the functional requirements.

4.5 Process flow analysis

To effectively analyze and optimize the Document Management System (DMS) at the local university, we employed a multi-faceted methodology incorporating user process usage analysis, flow visualization, and bottleneck detection. This approach enabled a thorough examination of the system's performance and identification of areas for improvement.

Initially, we categorized the university staff into administrative and academic positions to understand the distinct usage patterns of each group. Data on the frequency and duration of process usage was collected, providing insights into which processes were most frequently used and identifying those that required improvement. A heatmap was created to visually represent the distribution of process usage across different job roles, highlighting commonalities and differences in usage patterns between academic and administrative staff.

A scatter chart was used to see the relationship between the number of stages and the duration of each process. A scatter plot is a powerful visualization tool used to show the relationship between two numeric variables. They help identify patterns, trends, and clusters in the data. Dot plots can reveal deviations or anomalies that may need further study.

Subsequently, we constructed detailed flow diagrams for key processes to map

the sequence of activities and identify stages where delays occurred. This flow visualization allowed us to pinpoint specific stages that contributed to inefficiencies, particularly focusing on stages with durations that significantly deviated from expected timelines.

To systematically identify bottlenecks, we conducted a comparative analysis of process durations, examining the frequency and duration of incomplete processes to pinpoint stages with prevalent delays. Visualizations such as boxplots were utilized to highlight significant delays and inefficiencies within certain processes.

A detailed duration distribution analysis was then performed for processes identified with significant delays, providing insights into the stages contributing most to the overall duration. This analysis helped in developing targeted strategies to address the root causes of these delays.

Throughout the analysis, various data visualization techniques were employed to effectively communicate the findings. These included heatmaps, flow diagrams, and boxplots, which presented the data in an accessible and interpretable manner, facilitating the identification of patterns and the communication of the need for targeted optimizations.

By integrating these methods, we ensured a comprehensive and data-driven approach to identifying and addressing inefficiencies within the university's DMS, ultimately leading to the development of strategies for process improvement and optimization.

4.6 Comprehensive analysis of process forms

Managing electronic document environments involves navigating intricate networks of document repositories, systems, and organizations. These environments feature work processes that engage individuals across various organizations and roles. Standardizing documents aids in facilitating information exchange and enhances the management of system modifications. When designing standards, it is crucial to consider the context of documents and the various components of the document management environment [28].

The business procedure involves two primary parts: an examination of the process flow and a thorough evaluation of the forms utilized. Our approach to analyzing document forms adheres to established principles of user interface (UI) and user experience (UX) design, as well as documentation standards. Our methodology encompassed a detailed review of literature on UI/UX principles in documentation practices and a user survey to understand the needs and concerns of end users. Our methodology includes the following steps:

1. Evaluation of existing user interface elements.
2. Evaluation according to the principles of UX.
3. Compliance with documentation standards.
4. Creating prototypes for visualization.
5. Create a list of recommendations for improving forms.

UX: UX is defined as "a person's perceptions and responses that result from the use or anticipated use of a product, system, or service" [29] by ISO 9241-210, the worldwide standard on human-system interaction ergonomics. This includes

all of the interactions you have with a system or product before, during, and after you use it.

UI:The term "user interface" (UI) describes all of the hardware and software parts of an interactive system that provide controls and information to allow the user to carry out particular tasks with the system. The best user interface is one that is invisible to the user, allowing them to focus on the information and work at hand instead of the technical details that make the information and task appear on screen [30].

Documentation standards: Specific criteria are frequently included in documentation standards for electronic documents in order to guarantee uniformity, professionalism, and adherence to industry or organizational principles. These guidelines may call for certain components, such a list of approvals, a header, a footer, and a logo.

When UI, UX, and document standards are combined, electronic documentation takes on a more comprehensive approach. A document that is well-integrated will follow all relevant standards, offer a great user experience, and have an easy-to-use interface. In order to ensure that consumers can quickly access and comprehend the information they require, the document must be aesthetically pleasing, user-friendly, and consistently formatted.

Chapter 5

Analysis and findings

5.1 DMS standards overview

My work focuses on developing uniform requirements and optimizing the workflow of the Management System (DMS) in our institution. To achieve this goal, we have analyzed the relevant DMS standards and compiled a complete list of practices and functional requirements. The following table provides information about these methods, explanations, and evaluation of the DMS of the local university.

Table 5.1 – Evaluation of Local University Document Management System (DMS)

№	Uniform requirements	Functional requirements	Local University DMS
1	Uniform Requirements	Documentation	Requires improvement
		Consistency	Requires improvement
		Review and Update	Requires improvement
		Communication	Requires improvement
2	Document Classification	Classification Scheme	Requires improvement
		Ease of Use	No
		Training	No
		Automation	Yes
3	Naming Conventions	Standardization	Requires improvement
		Documentation	No
		Training	Yes
		Compliance	No
4	Access Control	Policies	Yes
		Implementation	Yes
		Review	Yes
		Monitoring	Requires improvement
5	Version Control	Versioning	Yes
		History	Requires improvement
		Retrieval	No

		User Training	No
6	Document Lifecycle Management	Lifecycle Stages	Requires improvement
		Policies and Procedures	Requires improvement
		Timeliness	Requires improvement
		Automation	Requires improvement
7	Audit Trails	Tracking	Yes
		Security	Yes
		Review	Yes
		Reporting	Yes
8	Backup and Recovery	Backup Policies	Yes
		Recovery Procedures	Yes
		Testing	Yes
		Security	Yes
9	Integration Requirements	Compatibility	Requires improvement
		APIs	No
		Workflow Integration	Requires improvement
		Testing	Requires improvement
10	Compliance and Legal Requirements	Regulatory Compliance	Yes
		Policy Development	Requires improvement
		Training	Yes
		Auditing	Yes
11	User Training and Support	Training Programs	Requires improvement
		Support Services .	Yes
		Feedback Mechanism	Requires improvement
		Continuous Improvement	Yes

In the table 5.1, we evaluated the local university document flow. The assessment was conducted according to 3 criteria: Yes - Available, No - not available, Requires improvement - requires improvement. The assessment was carried out on 11 uniform requirements and each requirement has a functional one for the requirements. The number of Yes is 43%, the number of no is 16%, requires improvement is 41%. In my opinion, this is a good indicator. Uniform requirements where all 4 functional requirements are required improvement is: Uniform requirements, Document lifecycle management.

In the following parts, we will analyze these functional requirements in more depth and try to make recommendations for improvement.

5.2 Thematic analysis result

The survey was conducted in two stages: collecting personal identification data and answering 11 questions that, in the opinion of each employee, can affect or improve the quality of the process. The survey was conducted by university employees holding administrative and academic positions. The survey was sent to all university staff to receive answers, and only 29 respondents were able to answer it. First of all, information about the user was requested. The questionnaire included the type of position, age and work experience.

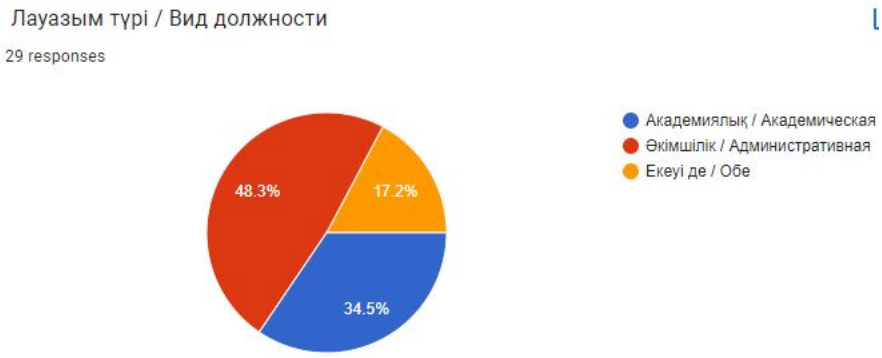

Figure 5.1 – DMS usage frequency

Figure 5.2 – Experience in years

The results of the first part of the survey are shown above in Figures 5.1, 5.2 and 5.3. According to the results available to us, most of the employees were in an administrative position. This means that the probability of obtaining an accurate result is higher, since administrative staff uses DMS on a daily basis, and knows more about the work of DMS. And 35% of respondents have more than 1-3 years of work experience, 24% of respondents are 3-5 years old, there are also respondents who have less than 1 year of experience and more than 10 years. From this, we conclude that this study involves employees with different amounts of experience.

Figure 5.4 shows the satisfaction of users of the DMS function. Respondents were asked to rate the convenience of functions such as Document Archive, Pro-

Figure 5.3 – DMS usage frequency

Figure 5.4 – DMS usage frequency

cesses, Start Process, Reports, and Dashboard using the categories: Convenient, Not convenient and Do Not Use. The bar chart shows that 86% of respondents rated the process of launching the function as convenient, which indicates a high level of satisfaction with this function. The document archive functions showed a bad result, according to the results of open questions, they found out the reason is the Unclear name of folders and files, which leads to the user not knowing how to search for the desired document. It is necessary to review the method of naming documents. The report and dashboard functions also did not show the best result. To improve these parts, additional work is required with users to find out the detailed information of the problem and solve it.

The open responses provided a deeper understanding of specific issues and suggestions for improvement. Topics identified as a result of these responses include:

User interface and design: Many users find the interface confusing and not intuitive. The improvement suggestions were aimed at improving the user interface (UX) to make it more user-friendly and intuitive. Add English. Sorting the archive is inconvenient. Sometimes it is difficult to find the submitted process. in the my processes section. Optimization of some processes. Add the deletion of canceled processes.

System performance : Some respondents noted the slow response time of the system. Recommendations were made to optimize system performance and reduce task execution time.

Processes that take a long time to get a response and are difficult to complete:

TEACHER PLAN 2, GPAY, SPAY, TEACHER REPORT.

These topics suggest that while the BPM system is generally well accepted, there are critical areas that need attention to improve overall user satisfaction and efficiency. By solving these problems, the organization can ensure that the system meets the needs of a diverse user base.

5.3 Process flow analysis and its result

The implementation of these functional requirements is crucial for the optimization of the DMS. Each requirement plays a vital role in ensuring the system is efficient, secure, and compliant. For example, robust version control and audit trails enhance transparency and accountability, while comprehensive user training ensures that all personnel can effectively use the DMS.

Document lifecycle management has functional requirements for lifecycle stages and timeliness. That's why we analyzed the dataset by time and life cycle stages.

As written in the previous parts, the processes are divided into the main 4 categories. To facilitate our analysis, the processes were divided into four main types: academic (teacher plan, office hour), governance (proposal), supporting (maintenance, gpay_22) and operational (prikaz, minor).

First, we conducted an analysis of the users and processes that they most often use. Since we do the analysis of the university, we divide the staff into administrative and academic positions. As a result, so that we understand which processes require improvement and to whom and for which processes to conduct training.

The number of academic staff is twice that of administrative staff. According to the results of the analysis, on the contrary, administrative employees use the document management system twice as much as academic employees.

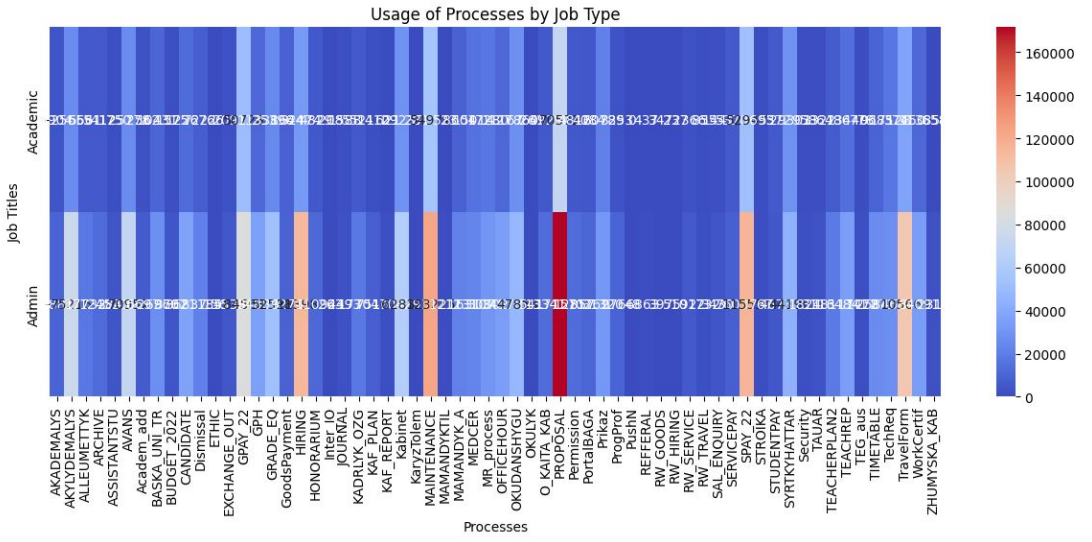

Figure 5.5 – Usage of processes by job type

A heat map has been created for all processes, which provides a visual represen-

tation of the distribution of process usage between various job roles in academic and administrative departments (see Figure 5.5). The figure shows that the academy and the administrative position often use the same processes. These Processes Are: Proposal, SPAY_22, GPAY_22, HIRING, MAINTENANCE.

Next, a scatter chart was created to find out the relationship between the number of stages and the duration. The scatter plot displayed in the image 5.6 illustrates the relationship between the average number of steps and the average duration for various processes. Each point on the graph corresponds to a distinct process, with the X-axis representing the average number of steps and the Y-axis representing the average duration in hours.

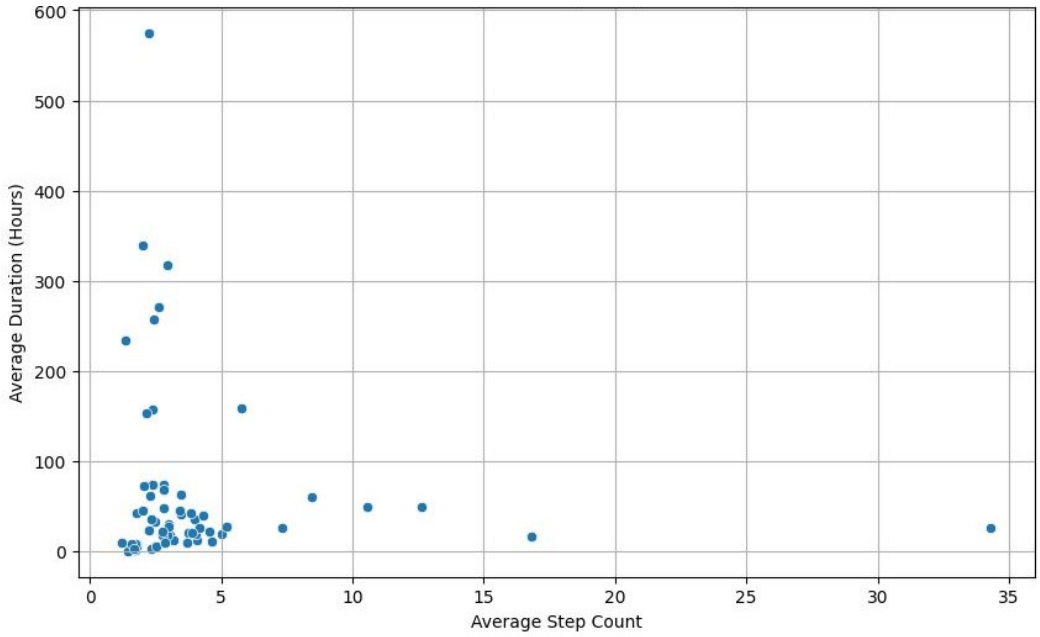

Figure 5.6 – Correlation between average duration and average step count

The points are significantly grouped around smaller values of the average number of steps and duration, which shows that many processes have fewer steps and shorter duration. Several points are distributed with a longer average duration and a different number of steps. Some processes with fewer steps still have a longer duration, which indicates that they can take a significant amount of time despite having fewer steps. There are anomalies with a very high duration (for example, about 600 hours) and a different number of stages. This may indicate complex or inefficient processes that require additional analysis.

To effectively communicate the findings, boxplots were used to visualize the duration of processes. These visualizations highlighted significant delays in certain processes, providing a clear depiction of inefficiencies and bottlenecks within the DMS.

Next, in Figure 5.7 we have built an illustration of the analysis of the duration of the processes. These 5 processes out of 60 are the most frequently used. You can see that it takes more than a year to complete some processes, such as SPAY_22, AKYLYDEMALYS, TEACHERPLAN2, PROPOSAL, MAINTENANCE.

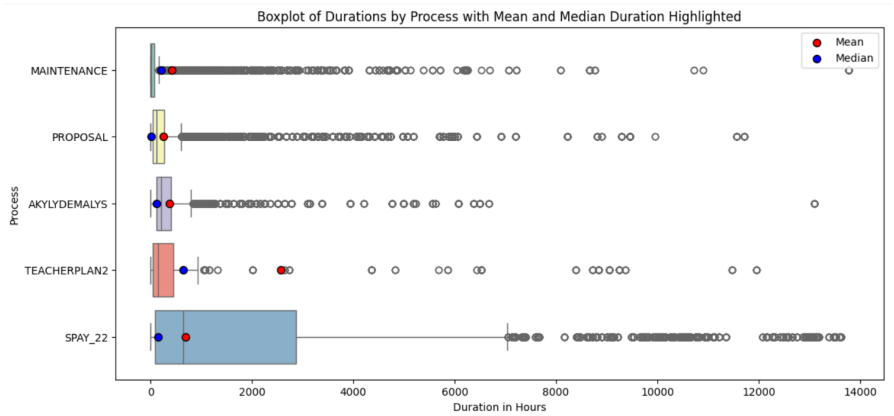

Figure 5.7 – Processes by duration

In 2 years, the Proposal process has started $\tilde{3}$8,000 processes, the TEACHERPLAN2 process $\tilde{3}$2000, the SPAY_22 process $\tilde{3}$100, the MAINTENANCE process $\tilde{2}$7000 and the AKYLYDEMALYS process $\tilde{1}$5000.

It is noteworthy that some processes, such as the "TEACHERPLAN2", are characterized by significant variability and deviations from the norm, and their duration reaches 12,000 hours. In contrast, processes such as "HONORARIUM" are characterized by a greater concentration of shorter time periods, indicating a more stable completion time. This visualization highlights the need for targeted optimization of processes, especially those with a long time interval, to increase efficiency and streamline operations in the organization.

To provide a clear example of the identified issues, we added a duration distribution analysis by flow object for the TEACHERPLAN2 process. The analysis (Figure 5.8) showed that the Starter flow object, which is the initial stage in the process, had the highest mean duration of 40 days, when the expected duration is 1.0 - 10.0 days. This significantly delayed the overall process completion time.

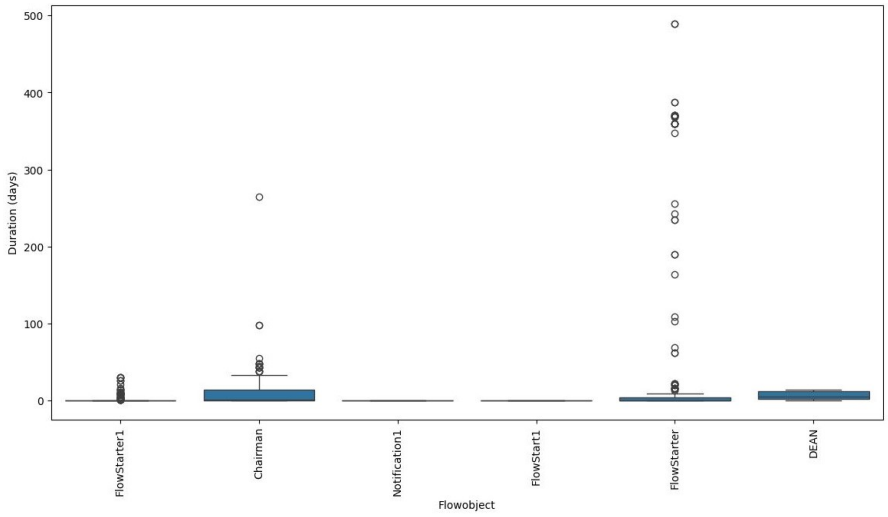

Figure 5.8 – Processes by duration

Additionally, we mapped out the flow of the TEACHERPLAN2 process to

understand how each stage contributes to the total duration. The flow diagram (Figure 5.9) revealed that delays at the Starter stage create a cascading effect, impacting subsequent stages and leading to prolonged process durations. This visualization underscores the importance of addressing the bottlenecks early in the process flow to enhance overall efficiency.

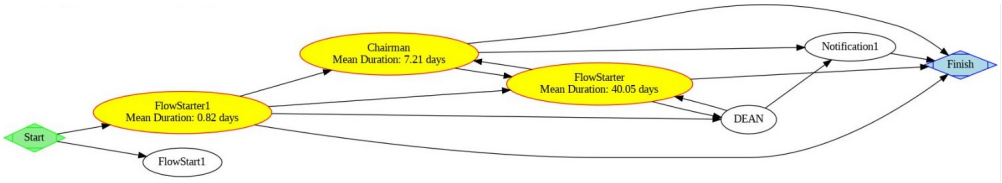

Figure 5.9 – Flow diagram for process: TEACHER PLAN2

The comprehensive analysis of the Document Management System (DMS) at local University revealed several key bottlenecks across different process categories. The identification of these inefficiencies is critical for improving the system's overall performance. Below, we present the major findings categorized by process type, along with the detailed analysis of process durations. The findings are summarized in the table below 5.2, showcasing the mean durations for key flow objects within each process category:

Table 5.2 – Mean Duration of Key Flow Objects by Process Category

Process Category	**Process**	**Flow Object**	**Mean Duration (days)**	**Expected Duration (days)**
Governance	Proposal	Starter	12.4	1.0 - 3.0
Supporting	TechReq	Responsible_person	15.8	1.0- 2.0
Supporting	MAINTENANCE	Technician	14.5	1.0- 2.0
Operational	GPAY_22	Responsible_person	16.3	1.0 - 5.0
Academic	TEACHERPLAN2	FlowStarter	40.05	1.0- 10.0

By analyzing the list of problems causing these delays, we identified specific issues contributing to the inefficiencies. One particular issue was chosen to demonstrate the result, but a comprehensive analysis was conducted for all identified problems. This thorough investigation aimed to uncover and address the root causes of delays, thereby optimizing the efficiency of the DMS at local University.

After working with the dataset, detailed standardization requirements were compiled. For consistency and efficiency of all processes, it is necessary to meet these requirements.

- Clear definition of the stages of the process: During the analysis of existing processes within our Document Management System (DMS), it became evident that lack of clarity in the definition of process stages led to misunderstandings and inefficiencies. By clearly defining each stage, including

inputs, outputs, and responsible parties, it becomes easier to understand and manage the process flow [31].

- Consistent Terminology: Create standardized terminology for all processes. During the analysis, the flowobject names were different for different processes. And this made it more difficult to draw conclusions and took time to check each analysis, to understand the result of the analysis. The effectiveness of standardized terminology will help when the number of processes grow and analysis becomes easier. Consistency of terminology helps to avoid misunderstandings and helps users not to get confused in understanding the process.
- Automated notifications: Implement automatic notifications of key events in processes, such as assigning tasks awaiting approval and that the process remains inactive for a set period (for example, one month). These notifications can prompt users to take timely action, reducing delays. During the analysis, it was noticed that there is no reminder of an inactive process. And the need to hire soon.
- Deletion Policies: Set and apply policies to delete inactive processes. This includes automatically sending notifications to users about incomplete processes and allows users to initiate the removal of suspended processes, which ensures the cleanliness and efficiency of the system. To do this, you need to determine what constitutes an inactive process. For example: it remained untouched for a month. Sending notifications and deleting at the user's initiative.
- Standard Operating Procedures (SOP): Document a detailed SOP for each process. These procedures should be a complete step-by-step guide that users can follow to ensure consistency. It is also necessary to study the rules for each process and set the execution time for each stage. This will help to optimize and reduce the running time of the process [32].
- Monitoring and reporting: Implement robust monitoring and reporting mechanisms to track the effectiveness of processes. Regular reports should include key performance indicators such as the length of the process, the number of delays, and completion rates, which helps identify trends and areas for improvement.
- View and update: Review and update standardized processes periodically to ensure that they meet the needs of the organization and best practices. This includes taking into account user feedback and adapting to changes in the operating environment to support the relevance and effectiveness of processes.

By implementing these proposals and detailed standardization requirements, the university can significantly improve the efficiency of its document management system, reducing delays and increasing overall process productivity.

5.4 Comprehensive analysis of document forms and findings

The university's workflow includes more than 60 unique processes, each of which includes various forms that range from simple entries in a single field to complex multi-field structures. A manual analysis of these forms was carried out in accordance with established user interface standards. According to the results of the analysis and survey, 80% of the processes are clear and easy to perform. However, when executing larger processes that contain many fields, problems arise. The Absence of prompts makes these processes less intuitive and more difficult for users. In addition, fields that need to be connected to the database can cause delays. Based on the results of the analysis and the survey, it was chosen to show one of the problematic processes in the work.

The interface shown in Figure 5.10 represents the form for the Teacher's Plan process, which a university employee views when initiating a new process. The numbers correspond to specific sections of the form. Below is a list of evaluation and suggestions:

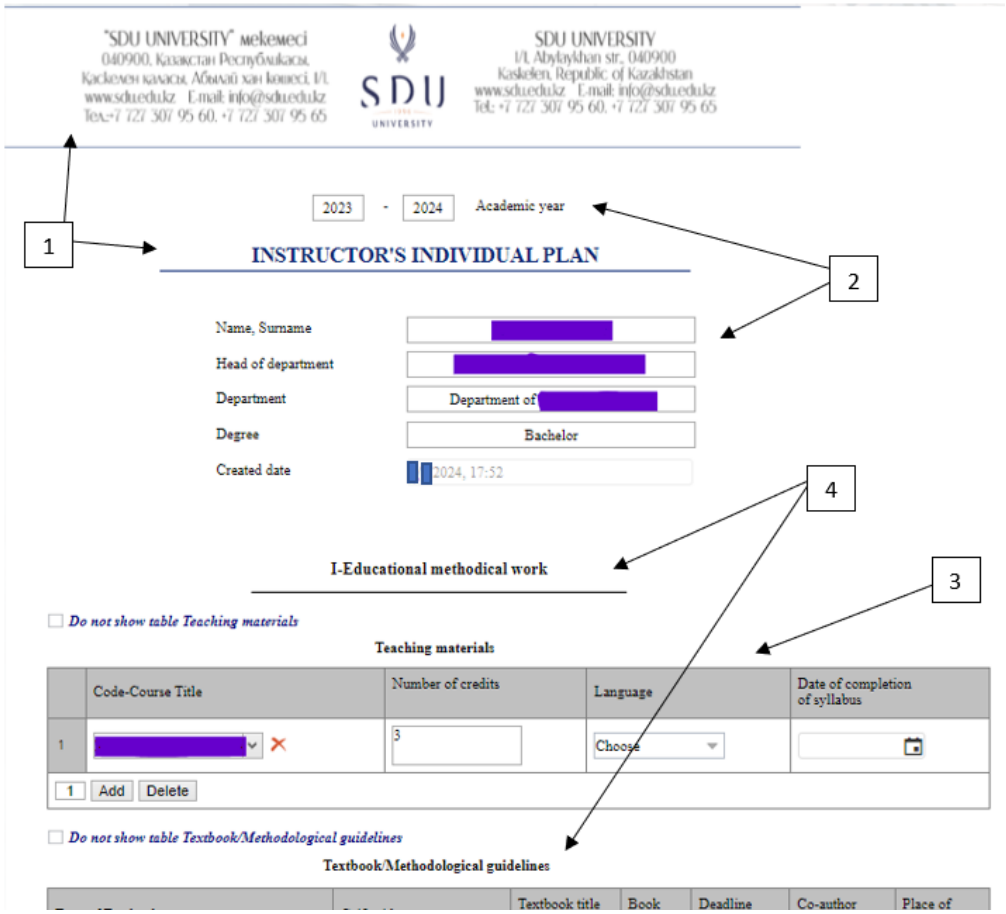

Figure 5.10 – Process Form: TEACHER PLAN2

1. Logo and Title: For institutional documents, the university's logo should be prominently placed to enhance brand awareness. The document must begin

with a clear process name at the top. For instance, the title "INDIVIDUAL TEACHER PLAN" should be correctly positioned to ensure immediate identification. Our processes have a properly placed logo and process names.

2. Header Information: The document header, placed at the top, is essential for conveying important information. It should include the document's creation date, the name of the author or group responsible, their department, and position. Contact details for the author should also be provided for any necessary clarifications. In many university processes, the document creator's name and the creation date are typically displayed. However, information such as position, department, and contact details may not always be included. Additionally, academic documents often feature the year of study and the teacher's degree, which adds a level of specificity and individuality to each process. At the bottom of the header, subsequent to the process creation date, a button can be added that links to a file containing the guide and samples of the completed process. This file should include the expected format and content, along with a detailed explanation.
3. The tables within the process exhibit a uniform design; however, the size of the fields designated for input is smaller than the size of the columns. It is necessary to reduce unnecessary spaces and lines. Adding examples within the cells will assist users in better understanding the required input. Incorporating a row selection feature will allow users to delete specific rows. Additionally, for tables that require database connectivity, pop-up hints should be included to inform users that the operation may take some time. Fields that are mandatory should be marked with a clear indicator, such as a red asterisk.
4. The headings of sections and tables should be increased in size so that they are larger than the table text. Utilizing bold text makes these headings more noticeable and effectively separates them into distinct parts. Proper alignment is also necessary. The headings used an appropriate set of words to clearly convey the content of the tables.

Applying these recommendations will resolve the identified issues, making the processes more user-friendly and effective. Enhancing the interface and ensuring the forms comply with established standards will greatly improve the user experience for university staff.

Chapter 6

Discussion and Conclusion

6.1 Discussion

The results of the flow analysis indicate that many processes frequently become stalled at the user who initiated them. This issue arises because the subsequent responsible positions often rely on the Document Management System (DMS) to monitor every process assigned to them. Only 10% of the university staff are designated as performers, while the remaining 90% are users of the services provided by administrative departments. A significant portion of these users, about 90%, do not track the latest updates to the processes they have initiated and, consequently, start new processes unnecessarily. This behavior negatively impacts the system over time, as it leads to the accumulation of redundant files, which in turn can slow down the overall efficiency of the process.

Additionally, in half of the cases, the reason for stalled processes is an incorrectly structured flow. During the initial creation of a process, it is often difficult for process owners to foresee all potential outcomes, which results in unexpected delays. Frequent monitoring and comprehensive analysis are crucial for improving these processes and resolving issues effectively.

6.1.1 Limitations of the study

The examination of stream objects is hampered by inconsistent naming conventions. This inconsistency necessitates extensive manual analysis to accurately interpret and understand the context and significance of these objects. Without a standardized naming system, researchers must invest additional effort to decode and correlate various terms, complicating data interpretation.

The study also faces substantial limitations due to the scarcity of relevant research papers. The limited availability of literature makes it difficult to compare results and draw comprehensive conclusions. This lack of existing research impedes reliance on established frameworks and methodologies, compelling researchers to adopt more fundamental approaches, which often involve developing new theoretical constructs and methodologies from scratch.

Additionally, technological limitations pose another challenge. Since the system under analysis is not a product developed by the university, the focus was directed

toward parts where process developers can implement improvements. This constraint further narrows the scope of the study, limiting the potential for comprehensive analysis.

6.2 Conclusion

In conclusion, every process could be optimized based on its query, flow logic, or UI/UX design. However, creating and maintaining a dynamic efficient DMS is not a simple task.

The findings of this study underscore the critical need for a systematic overhaul of the university's DMS, focusing on both structural improvements and user interaction enhancements. To address these issues, the following multi-faceted strategy is proposed:

1. Process Automation and Simplification: Implementing automation for routine, repetitive tasks and simplifying complex processes can significantly reduce the time required to complete tasks. This strategy not only speeds up process execution but also reduces the likelihood of user errors.
2. UI/UX Redesign: Redesigning the user interface and user experience of the DMS to make it more intuitive and user-friendly is imperative. This redesign should focus on minimizing the number of interactions required to complete tasks, improving navigational clarity, and ensuring that users can perform tasks with minimal training and confusion. The principles of human-computer interaction should guide this redesign, focusing on reducing cognitive load and enhancing user satisfaction.
3. Continuous Training and Support: Regular training sessions should be established to ensure that all users are fully capable of utilizing the updated system effectively. Training should be an ongoing effort to accommodate updates to the system and new users. Furthermore, a robust support structure should be in place to assist users in resolving issues promptly, thereby minimizing downtime and frustration.

In light of the findings from our analysis, several solutions are proposed to enhance the efficiency and effectiveness of the Document Management System (DMS) at the university.

1. Implementation of Notification Functionality: It is crucial to integrate a notification system that alerts users if a process remains stagnant for a specific period. This feature would prompt timely action, reducing delays and ensuring continuous workflow. Notifications can be in the form of emails, in-app alerts, or even SMS, depending on the urgency and importance of the stalled process.
2. Reduction of Process Steps: Simplifying the steps involved in various processes can significantly enhance the user experience and operational efficiency. By streamlining workflows and eliminating unnecessary steps, the system will become more user-friendly and faster, reducing the likelihood of bottlenecks and user frustration.
3. Providong relevant information: To execute a task, the worker must first identify the necessary information and locate it. Providing necessary infor-

mation from the start can boost efficiency even further. This assists office workers by tracking the steps in their processes and providing essential additional information, thereby speeding up the overall process. For instance, if a document includes a query, the intelligent agent will attach a previously stored document containing the response to that query, assuming it has been addressed before. This automation enhances efficiency by ensuring that necessary information is readily accessible, thus reducing the time needed to complete tasks.

4. Addition of a DELETE Button: From a UI/UX perspective, incorporating a DELETE button allows users to remove redundant or mistakenly initiated processes. This functionality prevents processes from becoming stuck without action, thereby maintaining a cleaner and more manageable workflow environment.

By implementing these recommendations, the university's DMS can better serve its users, improving overall satisfaction and operational effectiveness. These enhancements will also contribute to a more responsive and adaptable system, capable of meeting the evolving needs of the university's administrative and academic environments.

Future research should explore the integration of advanced analytics and machine learning algorithms into DMS. These technologies can be leveraged to predict workflow bottlenecks, automate document classification, and enhance search capabilities. Machine learning models can also be used to develop predictive maintenance schedules for the DMS, thereby reducing downtime and improving system reliability. Additionally, these models can help in identifying patterns and trends that may not be immediately apparent, providing deeper insights into document management practices and user behaviors. As cyber threats evolve, the security of DMS must be continuously improved. Future research should investigate advanced encryption techniques, multi-factor authentication, and blockchain technology to ensure the highest levels of data security and integrity. Additionally, developing frameworks for regular security audits and compliance checks will be crucial in maintaining robust security postures. Implementing real-time monitoring and alert systems can also help in early detection and prevention of potential security breaches.

Bibliography

[1] Abilla B. J Seniwoliba A. J, Mahama A V. Challenges of records management in higher education in ghana: The case of university for development studies. *International Journal of Educational Policy Research and Review*, 4(3):29–41, 04 2017. URL https://www.researchgate.net/publication/315697873_Challenges_of_records_management_in_higher_education_in_Ghana_The_case_of_University_for_Development_Studies.

[2] Šišovska Klančnik I Jordan S., Sternad Zabukovšek S. Document management system – a way to digital transformation. *Naše Gospodarstvo/Our Economy*, 68(2):43–54, 10 2022. URL https://intapi.sciendo.com/pdf/10.2478/ngoe-2022-0010.

[3] Gary P. Johnston and David V. Bowen. The benefits of electronic records management systems: a general review of published and some unpublished cases. *Records Management Journal*, 15(3):131–140, 2005. doi: 10.1108/09565690510632319.

[4] Rosemann M. Eds. Alonso G., Dadam P. Business process management. pages 1–15, 2007.

[5] M. Paulk. Capability maturity model for software. 01 2002. URL https://onlinelibrary.wiley.com/doi/abs/10.1002/0471028959.sof589.

[6] S. Bobek S. Sternad Zabukovšek, S. Jordan. Managing document management systems' life cycle in relation to an organization's maturity for digital transformation. 15(41):4–5, 2023. URL https://doi.org/10.3390/su152115212.

[7] Phil Vitkus Emmett Powell Dan Morris Marc Scarsig Denis Lee Gabrielle Field Todd Lohr Raju Saxena Tony Benedict, Nancy Bilodeau. Bpm cbok 3.0. pages 388–389, 2020. URL www.abpmp.org.ru.

[8] Mohamed Elhoseny, Noura Metawa, and Aboul Ella Hassanien. An automated information system to ensure quality in higher education institutions. *IEEE*, 2016.

[9] Southtech. Document management software - a ui/ux case study. https://www.southtechgroup.com, 2023. Retrieved: 2024-05-02.

[10] Maijastiina Mänty. Improving document management practices for nokia gear. Master's thesis, Turku University of Applied Sciences, Turku, Finland, May 2013. Bachelor's thesis.

[11] Olujimi Daniel Alao, Ezihe Amarachi Priscilla, Ruth Chinkata Amanze, Shade Oluwakemi Kuyoro, and Adewale Olanrewaju Adebayo. User-centered/user experience (uc/ux) design thinking approach for designing a university information management system. *Ingénierie des Systèmes d'Information*, 27(4):577–590, 2022. doi: 10.18280/isi.270407.

[12] Emanuel Gonçalves, Paulo Teixeira, and Joaquim P. Silva. Development of gdpr-compliant software: Document management system for hr department. In *2020 15th Iberian Conference on Information Systems and Technologies (CISTI)*, pages 1–6, 2020. doi: 10.23919/CISTI49556.2020.9140922.

[13] Michael Priestley and Mary Hunter Utt. A unified process for software and documentation development. In *Proceedings of the IEEE International Professional Communication Conference*, pages 221–237. IEEE, 2000.

[14] Hind Zantout and Farhi Marir. Document management systems from current capabilities towards intelligent information retrieval: an overview. *International Journal of Information Management*, 19:471–484, 1999.

[15] Bimser Çözüm. *eBA Coding Reference Guide*. Bimser Çözüm Software Trading Corporation, 2014. Version 1.0 / 24 November 2014.

[16] Wikipedia contributors. Document management system. https://en.wikipedia.org/wiki/Document_management_system, 2023. Retrieved : 2024-05-1.

[17] Bao Y. Alshibly H., Chiong R. Investigating the critical success factors for implementing electronic document management systems in governments: Evidence from jordan. information systems management. 33(4):287–301, 08 August 2016. doi: 1080/10580530.2016.1220213. URL https://www.tandfonline.com/doi/full/10.1080/10580530.2016.1220213.

[18] Yakimenko V.N. APutkina L.V. On the experience of implementing an electronic document management system using the example of usinskgeoneft. 2000 – 2028. URL https://elibrary.ru/item.asp?id=24984551.

[19] Nataliia Ridei, Nataliia Tytova, Tetiana Humeniuk, Svetlana Ishchenko, and Svitlana Sheremetieva. The main ways to solve the problems of document management in higher education (the ukrainian case). *Amazonia Investiga*, 12(61):212–223, 2023. doi: 10.34069/AI/2023.61.01.22.

[20] Republic of Kazakhstan. On electronic document and electronic digital signature. https://online.zakon.kz/Document/?doc_id=1035484&pos=5;-106#pos=5;-106, 2003. Retrieved: 2024-05-05.

[21] What are the 4 business processes? URL https://kissflow.com/workflow/bpm/faq/what-are-the-4-business-processes.

[22] MarketsandMarkets. Cloud-based document management system market by solution type and industry. 2021. Available at: https://www.marketsandmarkets.com/Market-Reports/cloud-based-document-management-systems-market-115223965.html.

[23] Gartner. Ai in document management: Predictions for 2025. 2022. Available at: https://www.gartner.com/en/documents/4000002.

[24] Statista. Mobile document management systems adoption survey. 2022. Available at: https://www.statista.com/statistics/794233/global-mobile-document-management-system-adoption/.

[25] Ponemon Institute. The state of document security in 2022. 2022. Available at: https://www.ponemon.org/library/the-state-of-document-security-2022.

[26] ISO/IEC Directives. *Procedures for the technical work*. ISO/IEC Dir, 2022. URL https://www.iec.ch/members_experts/refdocs/iec/isoiecdir1%7Bed17.0%7Den.pdf. Edition 17.0 2021-05.

[27] Parliament of the Republic of Kazakhstan. *Standardization*. 2022. URL https://online.zakon.kz/Document/?doc_id=38448599&show_di=1&pos=3%3B-106#pos=3;-106.

[28] A. Salminen, V. Lyytikäinen, and P. Tiitinen. Putting documents into their work context in document analysis. *Department of Computer Science and Information Systems, University of Jyväskylä*, 2000. Received 10 September 1999, Accepted 9 November 1999, Available online 18 April 2000.

[29] Alexander G Mirnig, Alexander Meschtscherjakov, Daniela Wurhofer, Thomas Meneweger, and Manfred Tscheligi. A formal analysis of the iso 9241-210 definition of user experience. In *Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems*, pages 437–450. ACM, 2015. doi: 10.1145/2702613.2732511.

[30] Wilbert O Galitz. *The Essential Guide to User Interface Design*. John Wiley & Sons, Inc., 2nd edition, 2002.

[31] John Jeston. *Business Process Management. Practical Guidelines to Successful Implementations*. Economics, Finance, Business & Industry, Engineering & Technology, 4th edition, 2018. doi: 10.4324/9781315184760.

[32] W. M. P. Van der Aalst. Business process management: A comprehensive survey. *ISRN Software Engineering*, pages 1–37, 2013. doi: 10.1155/2013/507984.