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DEVELOPMENT OF A DOCUMENT MANAGEMENT SYSTEM FOR AN ENTERPRISE BASED ON BUSINESS PROCESS MODELING

Abstract

This article will discuss the functionality of the electronic document management system. The interface, main functions and purpose of the application will be described here to guide the user. The electronic document management service was designed based on an analysis of existing solutions on the Kazakhstan market. When developing the application, we took into account standard functions present in most other services, as well as those that are missing there or implemented separately. This article consolidates the entire result of work on the project and helps to look at the final version of the application from the point of view of the end user. Having described each stage of working with the program, the author can also glean for himself some nuances and details that he had previously missed. The results of this project will provide an electronic document management system for enterprises seeking to improve their operational efficiency through the implementation of a modern electronic document management system based on business process modeling.

Key words: user, document, operation, document route, electronic digital signature, crypto library, digital signature key certificate.

Introduction

In today's dynamic business environment, effective document management and business process optimization are becoming key factors for enterprise success. In this context, the development of an electronic document management system based on business process modeling represents a practical and strategic solution to improve operational efficiency and increase the competitiveness of a company. Based on the analysis of existing document and business process management systems, through identifying their advantages and disadvantages, a system was created that allows us to fill the gaps of its predecessors.

The main emphasis is on developing electronic document management functionality that can improve the efficiency of business processes, reduce time costs and minimize the likelihood of errors. The results of the study provide practical recommendations for the implementation of an electronic document management system based on business process modeling to increase the competitiveness of an enterprise in the modern business environment.

With the development of the concept of "Electronic government", as well as the digitalization of many areas in modern Kazakhstan, there is a demand in society for maintaining electronic documentation. The sphere of document flow requires compliance with civil norms and laws, which is why it is necessary to analyze some important sources.

Before development began, an introduction was made to the basic terms of cryptography and encryption. In [1], the term "electronic digital signature" was first mentioned, which is why the article is significant from a historical point of view as one of the stages in the development of the entire field. [2] introduces the reader to the working mechanisms of one of the most common encryption algorithms – RSA.

Another layer of documents is regulations. It contains a large number of documents that regulate various aspects of electronic document management. [3] provides general concepts and definitions for most terms when working with electronic documentation. This act [4] presents rules for verifying electronic documents. In addition to the above documents, it is also worth paying attention to other regulations [5–6]. Some references to electronic documentation may also be found in these sources.

Some materials can be highlighted in foreign sources. [7] provides insight into the CMS standard, which is a universal method for storing electronic documents. Documentation for working with the XAdES and CAdES formats is described in [8] and [9]. These formats define standards when working with documents such as XML and PDF ([10]), respectively.

As part of the development of an electronic document management system, a study and analysis of aspects of data security when interacting with the service was carried out. For this purpose, a number of materials have been studied (some of them [11], [12]). Particular attention is paid to identifying and assessing potential security threats, developing appropriate measures to protect information, as well as introducing technical and organizational mechanisms aimed at ensuring the confidentiality, integrity and availability of data during system operation.

All of these materials provide an understanding of the scope of electronic document management in Kazakhstan, and also allow us to determine standard development standards.

Main provisions

As part of the master's thesis, a project for an electronic document management system was created. This project was implemented as a web application. The project is based on the goal of providing clients with functions that are not available in other similar systems. Therefore, an analysis of existing offers on the market was carried out in order to identify similar functions. In addition, the mechanism of working with electronic documents in the Republic of Kazakhstan was studied for a deeper understanding of certain difficulties.

Before starting work, the basics of web programming were studied in order to create the first version of the project. The development is based on the PHP programming language, supported by HTML, CSS and JavaScript. During the work, it also became necessary to add special frameworks and third-party free libraries in order to fully implement the functionality.

In addition, during the development, a database management system based on PostgreSQL and the NUC RK developer kit were used to work with electronic digital signatures.

The web application interface was an important part of the development. The interface of modern applications is important for the developer for several reasons:

♦ Interface defines the appearance, interaction, usability, behavior and overall experience of the application. A good interface can increase user satisfaction and loyalty and help achieve the application's goals.

♦ The interface affects the performance and efficiency of an application because it determines how users perform their tasks using the application. A good interface should be intuitive, simple and fast to minimize errors and time wastage.

♦ The interface reflects the values and reputation of the developer as it is part of the brand and identity of the application. A good interface should meet the expectations and needs of users, as well as convey the emotions and mood of the application.

During development, it was decided to make a user-friendly interface. A user-friendly interface is an interface that is easy for the user to understand and use. It does not require much effort from

the user to figure out how to work with the application. This type of interface makes interaction with the application pleasant and efficient. It also contributes to increased satisfaction and loyalty among users who appreciate the design and usability of the application and improves the performance and efficiency of the application, which allows users to complete their tasks using the application quickly and without errors.

To create such an interface, the developer must take into account the needs of the users and also follow some principles and techniques of interface design. For example, the interface should be simple, intuitive, consistent, adaptive, interactive and aesthetic.

During development, many tests were carried out to identify errors. It is important to consider that electronic documents are an important area of life for companies. The purpose of testing is to identify errors that can disrupt the operation of the system, cause an error for the client, and also clearly notify the user of the presence of any errors.

At the moment, there are points within the service that can be improved and expanded in terms of functionality.

The service is intended for use by individuals and legal entities operating in the territory of the Republic of Kazakhstan.

Software and hardware requirements for the system:

1. To work with documents, user will need an electronic digital signature key.

2. Technical requirements for working with the program:

- at least 2 GB of RAM;
- free disk space of at least 10 GB;
- Internet connection (at least 128 Kbps, recommended speed – from 1 Mbps);
- open access on port 443 for correct interaction with URLs;
- browser: Internet Explorer 10+, Firefox 4+, Opera 10+, Google Chrome 4+, Safari 5+;
- operating system: Windows 7/8/10/11, Linux, OS X 10;
- installed NCALayer application from NCA RK.

All tools and pictures used in the application were taken from publicly available free resources. In addition, most of the pictures are used only to demonstrate the operation of the application, and in the future they will be replaced using our own works.

Materials and Methods

The first thing that greets the user is the login page. A standard authentication mechanism for many websites is available here. The user can register if he has not used the service yet, or authorize an existing account. When developing this page, great attention was paid to data storage, because customer credential information is sensitive information and should be highly secure. User may not log in and work with limited functionality.

Then, the user is taken to the main page, where several functions are available to him. If the client is authorized, then three blocks are available to him: "My documents", "Sign" and "Verify document" (Figure 1, p. 57).

In addition, when starting work, the user can select the mode: , under which individual or legal entity he/she will work. EDS keys for legal entities and individuals are different, so it is important to correctly indicate the client's data. Specifying an individual allows representatives of small and medium-sized businesses to work with documents, and specifying a legal entity allows access to working with documents within the company. The registration process requires connecting NCALayer and entering the data of digital signature certificate. In this way, the user data will be saved in the system. In this case, the password and data of the key itself are not saved.

First of all, the client can sign any of his documents. To do this, he can go to the signature page and select the type of signed document (Figure 2, p. 57).

"Basic" and "Additional" signature methods are available here. The main ones include: signing a CMS document, signing an XML file and signing multiple documents. CMS signature allows user to sign a file of many popular formats, while saving data about the signature and the original document inside the CMS container itself. Files in PDF, WORD, EXCEL, etc. formats are suitable for this signature. The client needs to click the file selection button and specify the required file. A visual demonstration is available for PDF files (Figure 3, p. 58).
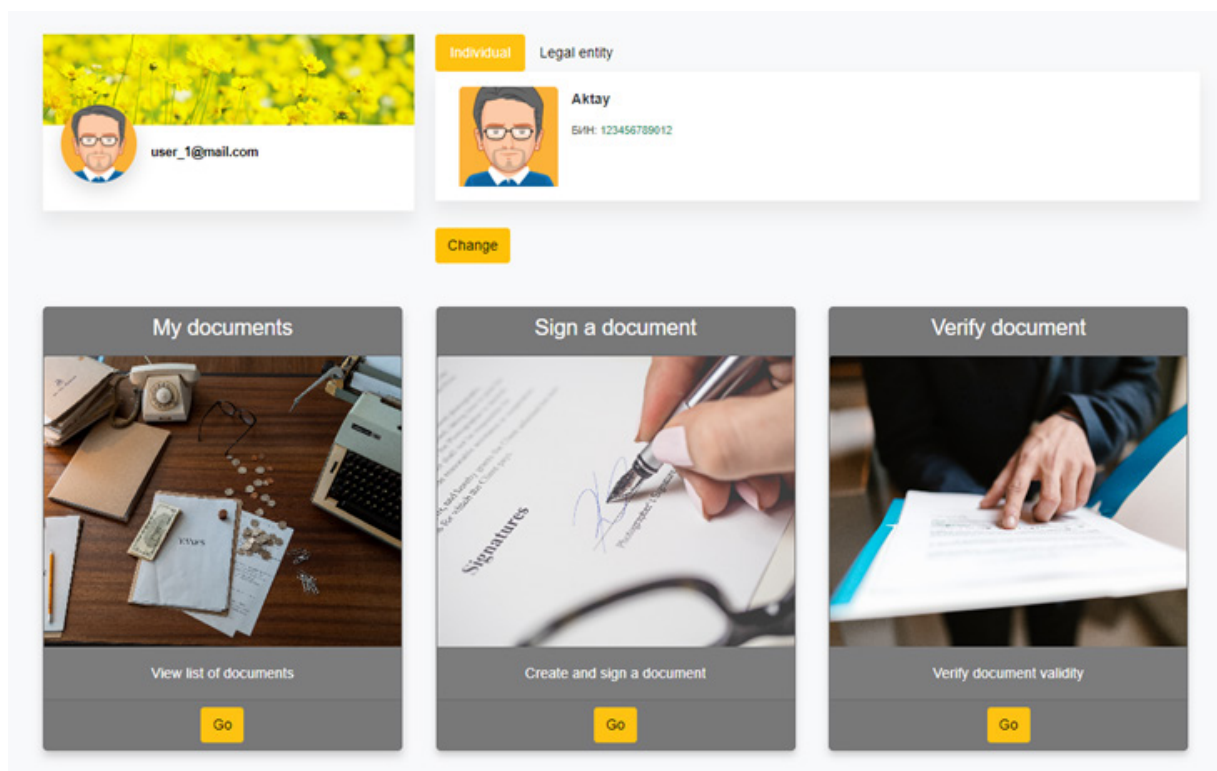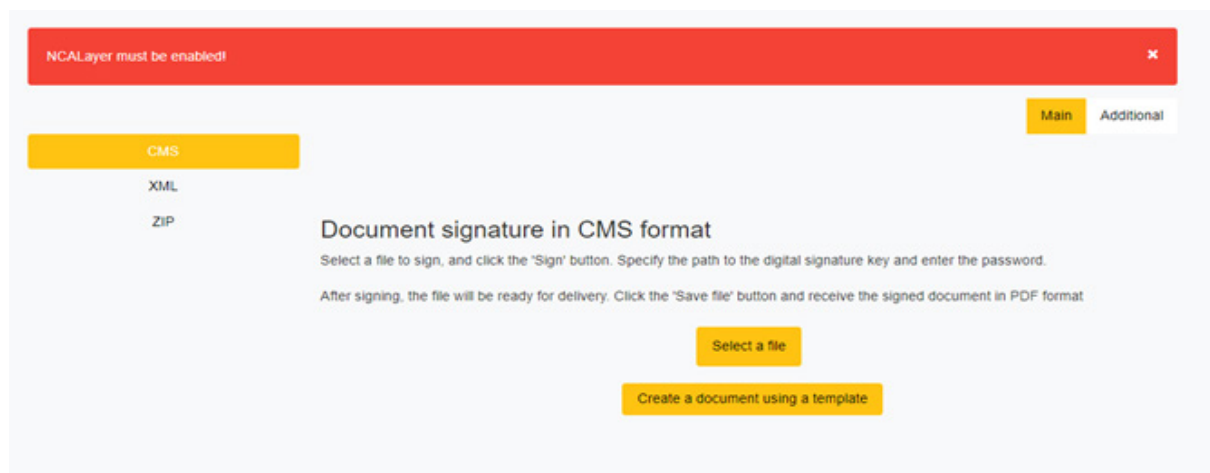

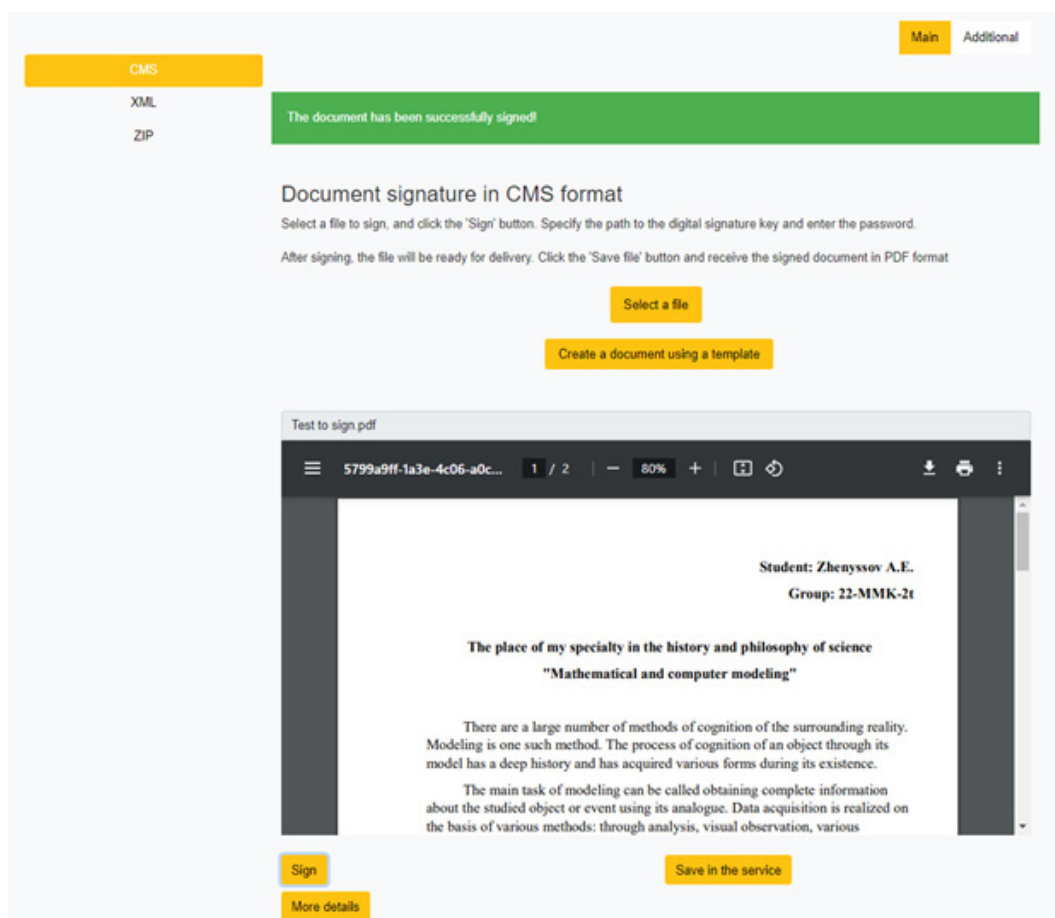Figure 1 – Home page

Figure 2 – "Sign document" page

Figure 3 – Signing a PDF file

Next, after checking that the file matches, user can click the "Sign" button, enter the key data in the NCALayer window and receive a notification whether the file is signed or not. If the signing is successful, a "More details" button appears; when clicked, the user is taken to the document page. A similar algorithm works for other methods. It's worth talking about additional signature methods. The document hash signature, byte array signature, and WS message signature are available here (Figure 4).
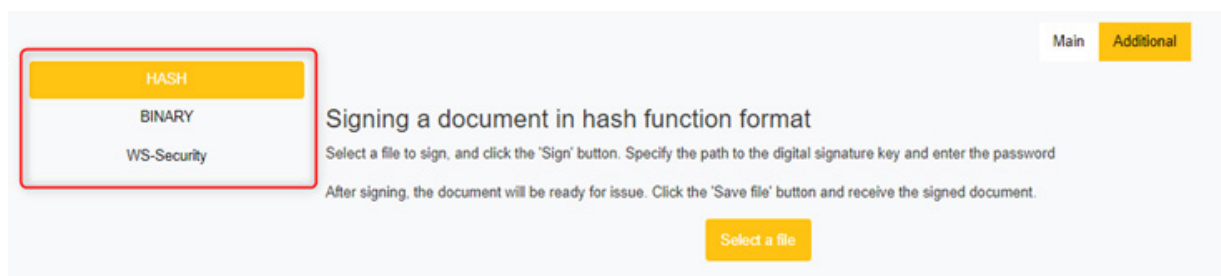

Figure 4 – Additional signature methods section

These types of files are not common, but can be used to interact with some government bodies (for example, the Taxpayer's Account portal accepts tax reporting forms in the form of WS messages). The mechanism for working with these methods differs from the main ones, because NCALayer is missing signature data. Therefore, similar functionality was implemented based on the KalkanCrypt

crypto library, which is also included in the developer kit. It is also worth mentioning that to implement the signing algorithms for several documents, it was not the standard version of NCALayer that was used, but a modification from 1C-Rating, which allows user to check the correspondence of the BIN of clients and the keys with which they sign. In addition, the page offers the opportunity to upload your own document and save it in the database without signing, with the function of further signing. Also, the service has several types of standard documents that are generated automatically without the need to download. For example, the document "Application for Leave" can be generated using the service.

The next section of the service is checking signed documents (Figure 5). The functionality for checking the validity of documents of different formats is implemented here.
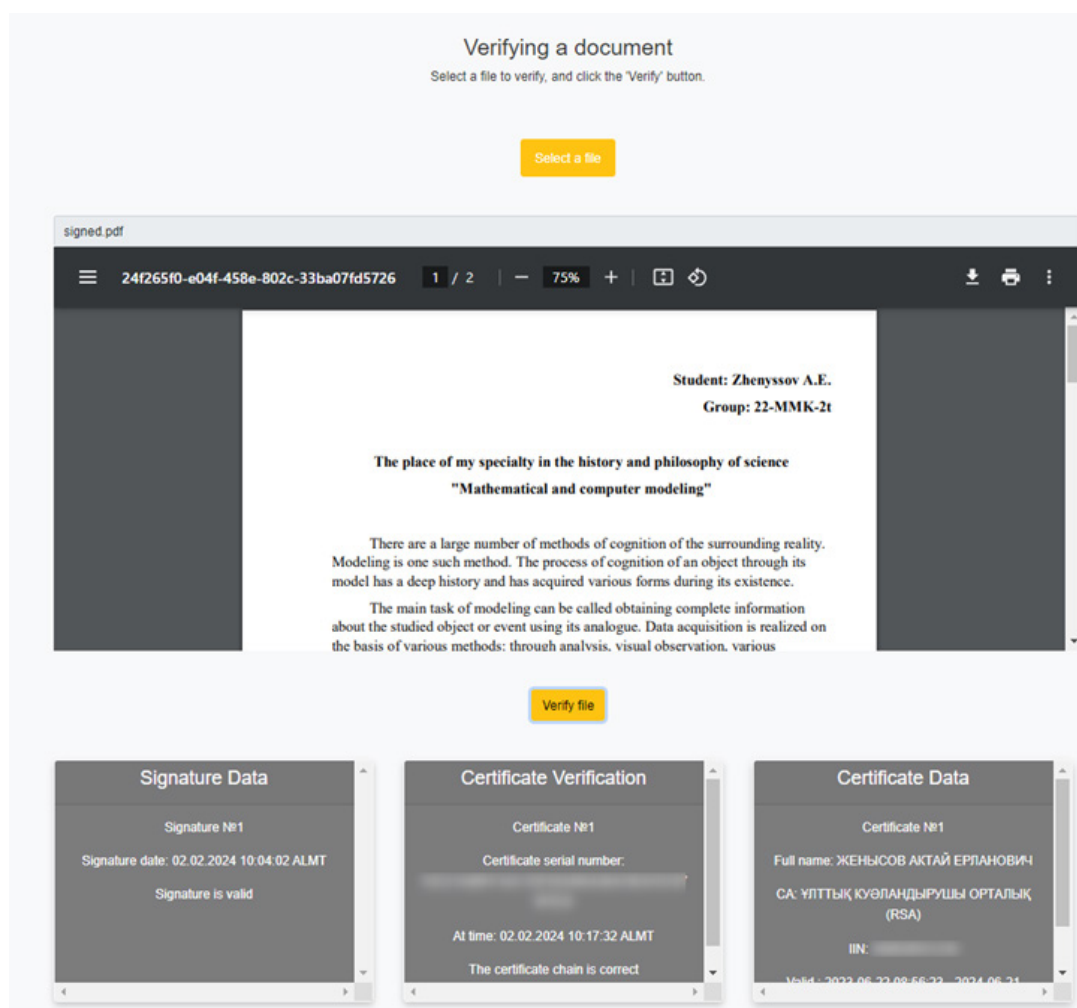

Figure 5 – "Check Document" page

Results

Currently, documents in CMS and XML formats are checked. Document verification is implemented using tools from the KalkanCrypt crypto library. To check the validity of the document, user must click the file selection button, and then the "Check" button. If a signature is found in a document, the service will issue a response in the form of several blocks, which indicate signature data (number of signatures, date of signing and current validity), certificate verification (serial number and certificate status), as well as signer's certificate data (name, certification center, BIN/IIN, validity date). The functionality of the page is the same for both authorized and unauthorized users.

In order for documents to be stored in the system, a server model was implemented within the service. This means that data on signed documents is stored in the system for a certain period of time. To work with documents, user need to go to the "My Documents" page, where various operations with documents are available. First of all, this is the storage of documents within the service. Here user can see signed and unsigned client documents (Figure 6).
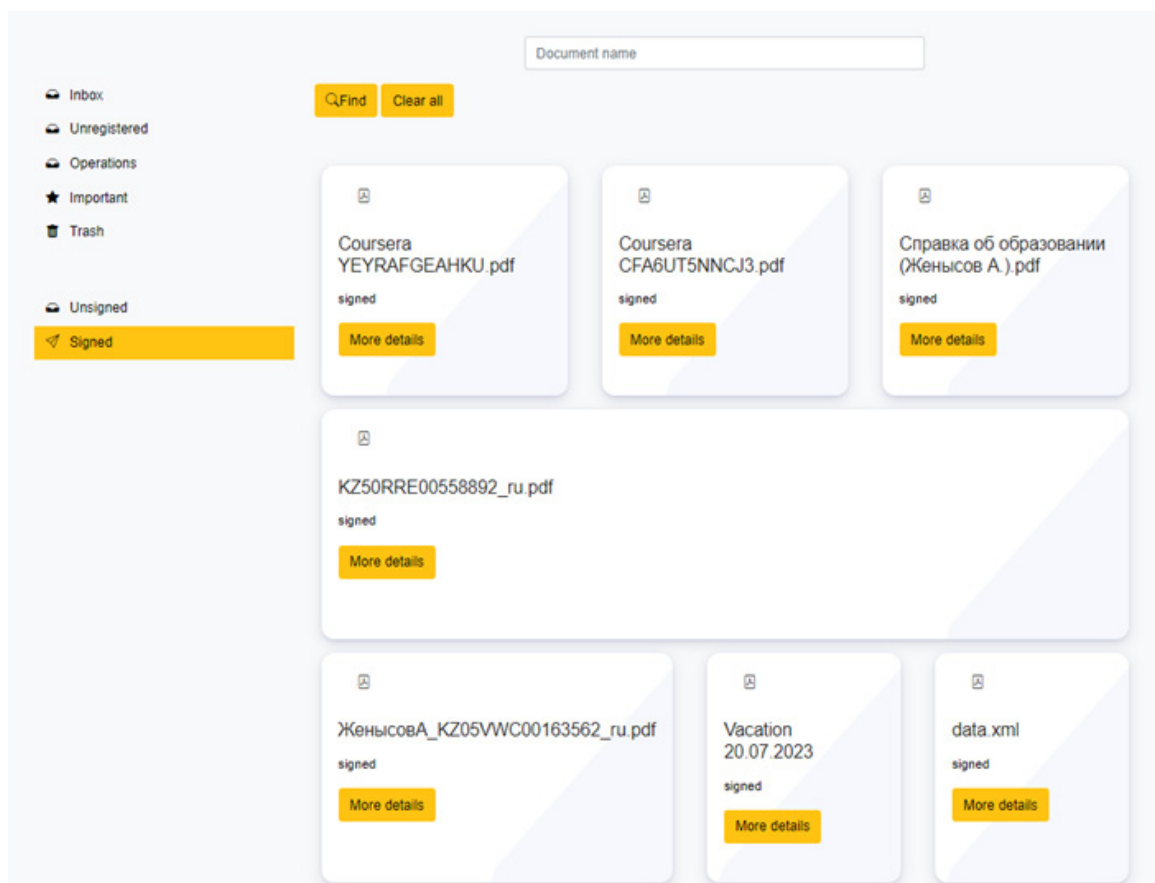

Figure 6 – User documents section

Each document has its own page on which user can see more detailed information about signatures (similar to the document verification page), send the document to counterparties, or download a zip container with signature information (Figure 7, p. 61).

When downloading the container, the user receives two documents: a signed document and a reference document, which contains all the signature information in printed form.

The signed document can be used for further operations, in particular, it can be verified through the "ezSigner" service, which is one of the popular services for verifying electronic documents in the Republic of Kazakhstan. Sending documents is implemented from several angles. Firstly, sending occurs between users of the service. There are no obstacles here; the service sends documents through internal sending mechanisms. This is implemented in the document sending block, through a separate modal form.

Discussion

However, it was decided that the transit of documents should be carried out not only between authorized clients, but also between others. Therefore, it is possible to send a document to an

unauthorized user via email. To do this, when sending, a letter is generated to the specified email address with a unique code that is valid for a limited time. The counterparty must enter the code on a unique code entry page in order to access the document page and sign it.
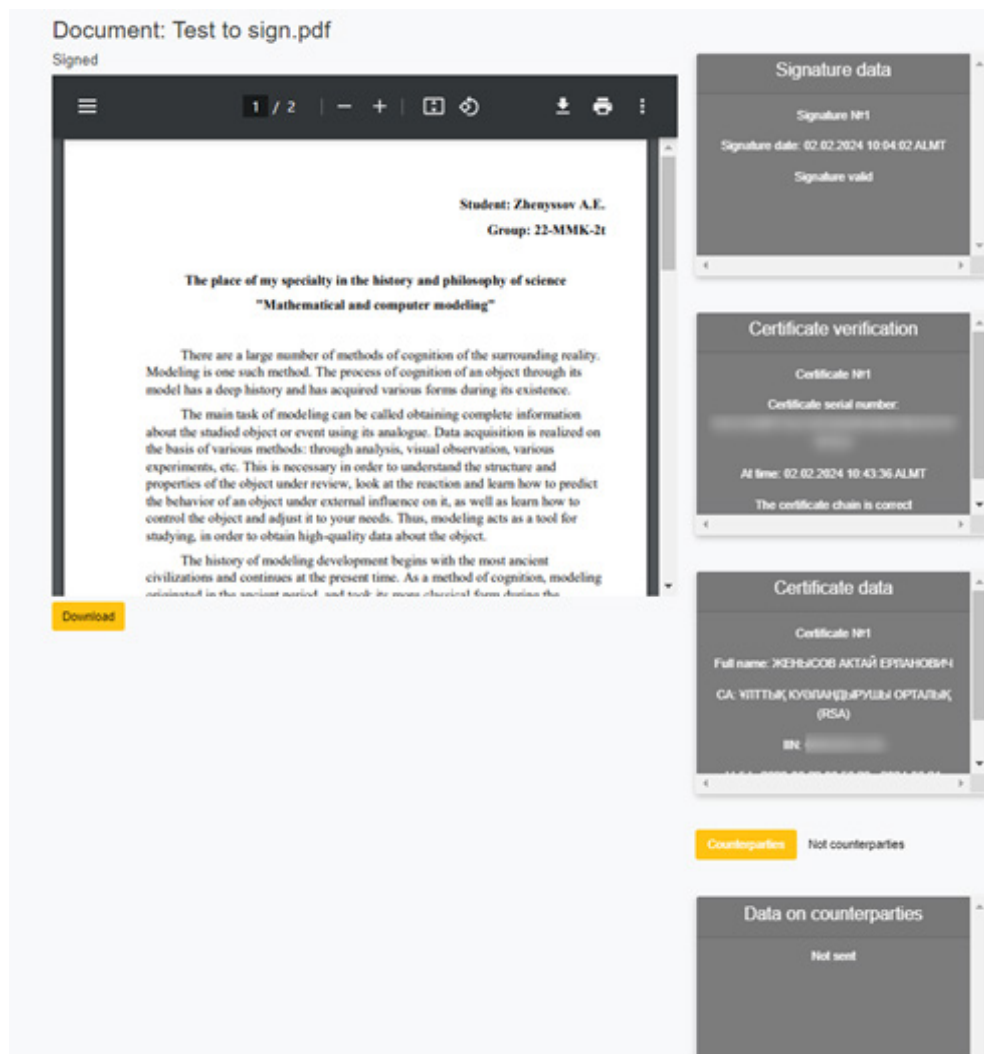

Figure 7 – Document page

In the future, it will be possible to get to the document page using this code. An algorithm for sending documents within the company has also been implemented. To do this, use a special section "Operations" (Figure 8, p. 62), where user can specify any document from list and send it to any members of the company in which the sender is listed for signing.

User can also request certain employees to sign documents of the same type. Inside the service, on the pages of the "My Documents" section, user can see both incoming and outgoing documents. User can click on each message and see the text from the sender and the attached document. Thus, the basic algorithm for electronic mail services was implemented.

In the process of working on the service, some of its advantages and disadvantages were identified over other services that work with electronic signatures of the Republic of Kazakhstan (Table 1, p. 62).
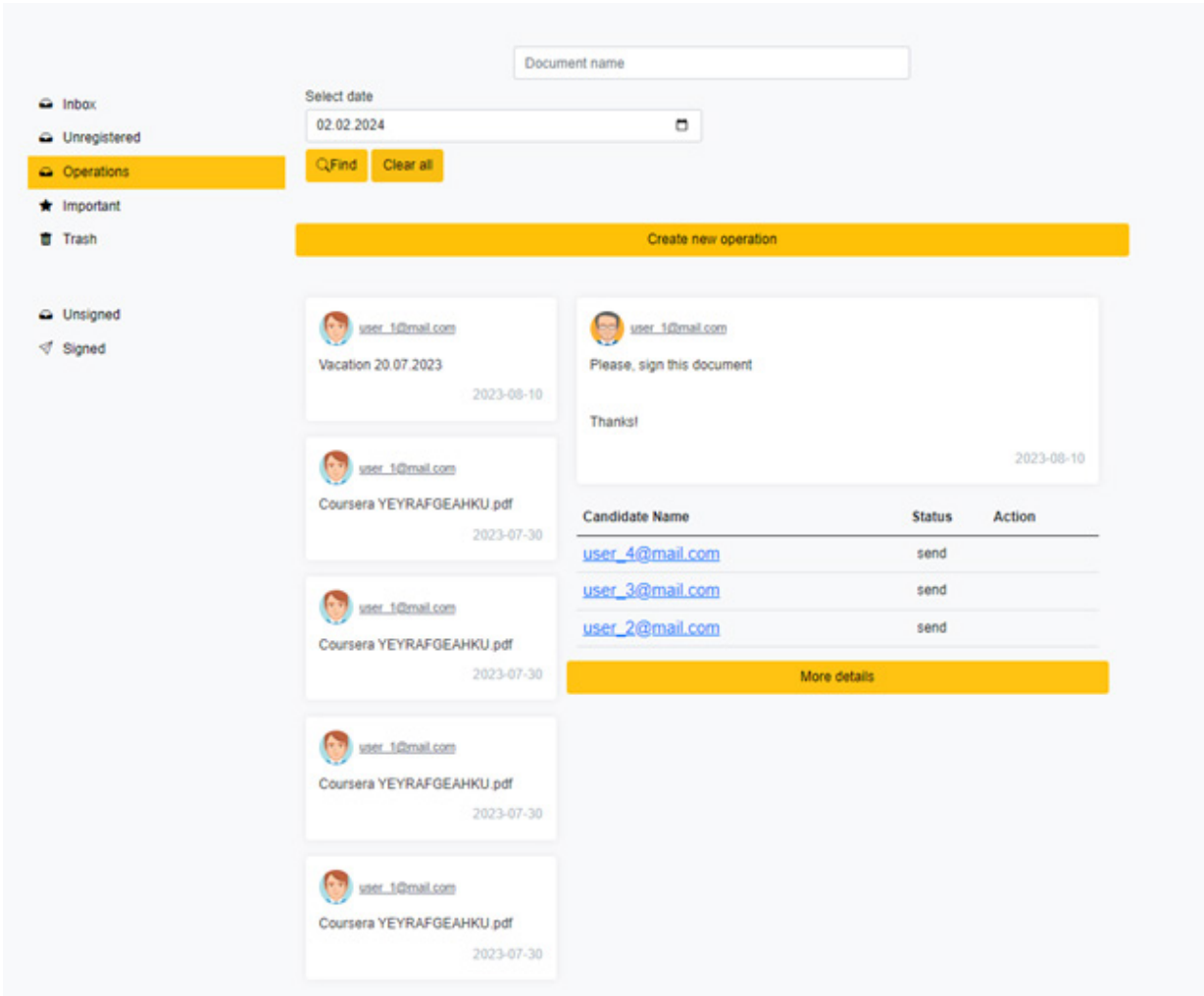
Figure 8 – Section "Intra-company operations"

Table 1 – Advantages and disadvantages of the project

Advantages	Disadvantages
Document formats implemented by NCA were added to the service. These formats include both common (XML, PDF, Word and Excel) and less familiar types to the general user (binary data, document hash functions, WS messages).	The interface and behavior of some features is very basic in functionality and lags behind others. This is due to the amount of work that requires a much larger amount of time, money and people to develop the project.
One of the advantages of the system is the ability to work in unauthorized mode. Many services require at least registration via e-mail to receive the basic functions of the program, and sometimes additional payment is required to work with the full version.	Lack of an advanced security system. Implementing a cybersecurity system requires in-depth knowledge in this area. Many services resort to the use of third-party developments or the services of specialized companies. The application implements basic functions to protect information.
It is based on the "open code" model, with the creation of a universal code for further implementation in companies of any structure and specialization. The service will be convenient for large enterprises that have their own staff of developers.	Not identified

The created application also involves a transition to an «open source» model, with the creation of a universal code for further implementation in companies of any structure and specialization. Thus, the service will be convenient for large enterprises that have their own development staff. At the same time, aspects of legislation are taken into account, which is why some functionality requires coordination with government agencies.

Conclusion

As a result of the design, we can come to the conclusion that the development and implementation of an electronic document management system based on business process modeling is an integral step in modern business. The practical significance of this project lies in the real possibility of increasing the efficiency of document management and optimizing key business processes of the enterprise.

During the implementation of the project, the advantages of an electronic document management system were identified, based on reducing the likelihood of errors and adding functions that are missing in other systems. These factors contribute to the overall effectiveness of the service, helping to increase its competitiveness in a dynamic market environment.

Based on the data obtained, a practical solution has been created for enterprises that decide to implement such systems. An electronic document management system, created on the basis of business process modeling, is an effective tool for modern organizations seeking to improve their operations and strengthen their leadership in the market.

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БИЗНЕС-ПРОЦЕСТЕРДІ МОДЕЛЬДЕУ НЕГІЗІНДЕ КӘСІПОРЫННЫҢ ЭЛЕКТРОНДЫҚ ҚҰЖАТ АЙНАЛЫМЫ ЖҮЙЕСІН ӘЗІРЛЕУ

Андатпа

Бұл мақалада электрондық құжат айналымы жүйесінің функционалдығы талқыланады. Пайдаланушыға бағыт-бағдар беру үшін интерфейс, қолданбаның негізгі қызметтері мен мақсаты осы жерде сипат талады. Электрондық құжат айналымы қызметі Қазақстандық нарықтағы қолданыстағы шешімдерді талдау негізінде жасалған. Қолданбаны әзірлеу кезінде біз басқа қызметтердің көпшілігінде бар стандартты қызметтерді, сондай-ақ ол жерде жоқ немесе бөлек орындалатын қызметтерді ескердік. Бұл мақала жоба бойынша жұмыстың барлық нәтижесін біріктіреді және қолданбаның соңғы нұсқасын соңғы пайдаланушы тұрғысынан қарауға көмектеседі. Бағдарламамен жұмыс істеудің әрбір кезеңін сипаттай отырып, автор өзі үшін бұрын жіберіп алған кейбір ерекшеліктер мен мәліметтерді де жинай алады. Осы жобаның нәтижелері бизнес-процестерді модельдеуге негізделген заманауи электрондық құжат айналымы жүйесін енгізу арқылы операциялық тиімділігін арттыруға ұмтылатын кәсіпорындар үшін электрондық құжат айналымы жүйесін ұсынады.

Тірек сөздер: пайдаланушы, құжат, операция, құжат маршруты, электрондық цифрлық қолтаңба, криптовалюта, ЭЦҚ кілтінің сертификаты.

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РАЗРАБОТКА СИСТЕМЫ ЭЛЕКТРОННОГО ДОКУМЕНТООБОРОТА ПРЕДПРИЯТИЯ НА ОСНОВЕ МОДЕЛИРОВАНИЯ БИЗНЕС-ПРОЦЕССОВ

Аннотация

В этой статье будет рассмотрен функционал системы электронного документооборота. Интерфейс, основные функции и назначение приложения будут описаны здесь для руководства пользователя. Сервис электронного документооборота был разработан на основе анализа существующих решений на казахстанском рынке. При разработке приложения мы учитывали стандартные функции, присутствующие в большинстве других сервисов, а также те, которые там отсутствуют или реализованы отдельно. Эта статья обобщает весь результат работы над проектом и помогает взглянуть на окончательную версию приложения с точки зрения конечного пользователя. Описав каждый этап работы с программой, автор также может почерпнуть для себя некоторые нюансы и детали, которые он ранее упускал. Результаты этого проекта позволят создать систему электронного документооборота для предприятий, стремящихся повысить эффективность своей деятельности за счет внедрения современной системы электронного документооборота, основанной на моделировании бизнес-процессов.

Ключевые слова: пользователь, документ, операция, маршрут документа, электронная цифровая подпись, криптобиблиотека, сертификат ключа ЭЦП.