Modeling of the electronic document circulation and record keeping system in the processes of cargo transportation in railway transport

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Abstract. This article focuses on modeling an electronic document circulation and record keeping system for cargo transportation in the railway sector. Its primary objective is to develop an efficient system that automates document circulation and office processes, thereby enhancing work efficiency and reducing costs. The article highlights key aspects of modeling and operating the electronic document circulation system. The authors review existing approaches and technologies in this domain and propose a new approach tailored to the specific characteristics of the railway industry. Benefits of implementing electronic document circulation and record keeping in the railway sector are discussed, including accelerated document processing, improved accuracy and reliability of information, and reduced costs associated with paper carriers and document storage. The article also addresses the prospects and challenges associated with implementing such a system within the railway network. The research findings are valuable for railway company specialists and managers seeking to enhance efficiency and reduce costs in document circulation and administrative processes. The proposed system can serve as a foundation for developing and implementing an electronic document circulation and record keeping system in the railway sector, leading to significant performance improvements and cost reduction.

1 Introduction

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allows to significantly simplify and speed up these processes, as well as to increase the quality of service and reduce costs. In order to determine the relevance of the research, we need to find an answer to the following question: why modeling and operation of the electronic document circulation system is an important and necessary task in the processes of cargo transportation in railway transport. Arguments are made as to why existing workflows and clerical processes require improvement and automation, as well as how problems and issues can be solved by implementing electronic document flow.

Research goals and objectives: what the authors plan to achieve as a result of their work. The goal is to develop an effective electronic document circulation system that allows increasing efficiency and reducing costs in the railway sector. Research objectives include analyzing existing approaches and technologies, developing a system model, evaluating the effectiveness and benefits of using the system, and making recommendations for implementation.

2 Analyses and Discussion

Various systems and technologies used in this field, their advantages and disadvantages are considered. A comparative analysis of existing approaches was carried out, and the main problems that could be solved by modeling the electronic document circulation and record keeping system were identified.

Description of existing systems and technologies: Various software products, platforms and solutions already in use for the automation of document circulation and office work in railways are reviewed. Their main features, functionality, integration options and use cases are described.

Advantages and disadvantages of existing approaches: Pros and cons of different systems and technologies, their efficiency, reliability, ease of use, degree of automation and other aspects are considered. It also identifies challenges and limitations faced by existing approaches and opportunities for improvement.

The electronic document circulation system (hereinafter referred to as EDCS) enables effective management of documents and work processes by collecting and storing information in the central fund of documents. Documents can be retrieved quickly and easily anywhere, anytime and from any platform. Security, auditing, version control and retention policies are easy to configure and manage. This ensures compliance with the rules and access to confidential documents only to those who have the right to see them.

Data can be extracted from paper and electronic documents for automatic indexing and classification. Data can be validated against existing internal systems or transferred to other applications for further processing.

EDCS is also used to provide centralized control and secure storage of documents related to the rights and welfare of each client and employee.

3 Methods

Document and business process management systems such as DocsVision, PayDox and FileHold are considered during the research. Based on the above, it can be highlighted the main requirements for electronic document circulation systems:

- security;
- ease of support and configuration;
- scalability;
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- Ability to work in real time;
- Integration with other systems;
- Several methods of working with the system;
- Search capabilities;
- Cost.

Security - the existence of a number of measures that allow solving information security issues, for example, two-factor authentication, digital signature, encryption.

Scalability is the system's ability to cope with increased workload. Several ways to interact with the system are the ways users interact with the system, such as using a mobile application.

Price is one of the main factors. The price should correspond to the financial capabilities of the organization.

A comparison of the above EDCSs according to these criteria is presented in Table 1.

**Table 1. Comparing EDCSs**

<table>
<thead>
<tr>
<th></th>
<th>Mezon</th>
<th>DocsVision</th>
<th>PayDox</th>
<th>FileHold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Security</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Ease of support and setup</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Scalability</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Ability to work in real time</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Integration with other systems</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Several ways to work with the system</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Search options</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Cost</td>
<td>+</td>
<td>-</td>
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<td>-</td>
</tr>
</tbody>
</table>

Based on the above materials, the introduction (creation) of EDCS allows us to create accounting, storage and interaction systems of documents in the shortest possible time, as well as not only the organization of organizational work and errors caused by human error allows to reduce the number.

Modeling of the electronic document circulation and office system: The requirements and functionality of the system are determined, the system model is developed using appropriate modeling methods and tools. Model testing and validation is done to ensure its accuracy and reliability.

Modeling of the electronic document circulation and administration system includes the description of its main components, the interaction between them, document processing algorithms, access and control rules, as well as other aspects that affect the operation of the system. The model can be presented in the form of diagrams, charts, mathematical equations or other formal representations.

Modeling of the electronic document circulation and office system allows to analyze and optimize the operation of the system, to identify problems and problem areas, as well as to propose improvements and changes to increase the efficiency and reliability of the system. This is an important stage in the development and implementation of the electronic document circulation and record keeping system.

The modeling process is actually a way of trying to transform data ⇒ information ⇒ knowledge ⇒ understanding.

Understanding how to use the model provides an understanding of the technologies to be used in the modeling process. It should also be noted that, unusually, the process of methodical problem definition can achieve the desired goals without the use of advanced tools.
modeling; a systematic understanding of the target system, problems, and "out
of
the
envelope" analysis may be sufficient.

Step 1: Identify the goal
The first step in any modeling process is to define the goal. This step looks at ways to think about defining the objective function of the model in relation to the overall strategy of the company as well as the business goals. Several modeling techniques are discussed, including linear regression, logistic regression, and classification trees. Many types of models are explained, including response, activation, risk, maintenance, and life-cycle costing. The main thematic examples are presented.

Step 2: Collect data
A clear, and actionable data is the foundation of any successful model. At this stage, various types of data are considered, as well as their many internal and external sources. Many examples of collecting and/or generating real samples for model development are provided.

Step 3: Prepare data for simulation
About 60% of the time is spent on data preparation. This step details the entire data preparation process, starting with describing the types of data and describing how they can be adapted for predictive modeling. Several techniques have been introduced to deal with common data problems such as missing values and outliers.

Step 4: Select and change variables
To determine the best fit is essential for good model performance. The underlying structure of the independent variables relative to the dependent variable determines the strength and longevity of the model. This step details the steps for combining and transforming the independent variables to provide the best fit to the dependent variable. Special attention is paid to the fact that data can have hundreds or even thousands of variables. A program can be implemented that automatically segments and transforms the strongest variables to ensure the best fit. Finally, the selection methods are combined to easily bring the most relevant variables into the final step of the modeling process.

Step 5: Model processing and evaluation
All the preparation up to this point will make this step easier. Several methods of model refinement and estimation are presented here, with a practical discussion of the ideal number of variables. The Weight of evidence and information values are calculated.

Step 6: Check the model
By definition, models should work well with development data. Also, if the sampling is random, the performance of the model should estimate the validation data with similar results. The true test of a model's performance is how well it performs with other time or market data. This step demonstrates three powerful techniques for model fitting. evaluating alternative data is the best way to determine if the model will work in a real campaign; uses simple resampling techniques to find confidence intervals around bootstrap estimates; key variable analysis calculates important market factors depending on the model and thus provides reasonable results.

Step 7: Implement and save the model
An effective implementation is a combination of business intelligence and well-designed procedures. This step starts with estimating the new data set with the new model. Several audit procedures are discussed. A model tracking and the maintenance are highlighted as best practices.

The modeling includes the following steps:

- to determine the purpose and object of modeling;
- the choice of modeling apparatus, constraints, variables;
- the selection of evaluation criteria;
The main tasks of modeling are as follows:
- to increase the efficiency of administrative activity;
- to speed up the movement of papers;
- to reduce labor costs for paper processing.

To model EDCS, we define a mathematical modeling apparatus. Organizations use a composite workflow—it involves both types of documents: electronic and paper. The composite work process can be shown as follows:

\[ H_t = \{F, A, T\}, \]

where \( H_t \) is the document circulation model, \( \{F\} \) - set of participants, \( \{A\} \) - set of actions, \( \{T\} \) - a collection of document states.

A document circulation is a set of actions performed by multiple participants on a set of document states. \( \{F\} \) - a set of participant roles that can be assigned within a work process. \( \{A\} \) - a set of document actions that can be performed within the EDCS in question. \( \{T\} \) - a set of states after actions are performed on documents.

Thus, the system consists of sets consisting of certain elements, and these sets can be changed during the life cycle of the workflow processes. Changes in the elements of the sets are carried out discretely, so that any step corresponds to the system \( \{F, A, T\} \) with a static composition of the sets. In addition, the set consisting of elements \( \{F, A, T\} \) describes the actions that occur in the system with respect to time.

Therefore, the participant's actions can be represented as a sequence of document states. The set of all cases is a limited set that fully represents all possible actions of the participants. The initial state is the state that the document enters after the start of the process. So, the elements of the set \( T \) with no incoming connections and one or more outgoing elements are initial state objects.

A final state is a state in which the elements of set \( T \) have no outgoing links, but one or more incoming links.

A work process includes a set of processes that process documents. The life cycle of the work process is determined by the transition of documents from the initial state to the final state.

4 Results

The UML diagrams representing different aspects of the EDCS logic model have been developed, this complex includes the Use Case diagram shown in Figure 1 and the Activity diagram shown in Figure 2, which respectively represent the functional and dynamic aspects of the EDCS logic model. The logical model obtained from modeling is the basis for software development and the relational data model of EDCS.
The account operations include operations related to working with the account (creation, editing, deletion). The create new account operation is invoked when a new employee is hired, the edit operation is invoked when the employee's personal information is changed, and the delete operation is invoked when the employee is fired.

The operations with document templates include operations related to working with templates (moving, deleting, editing). If the default shape of a template is changed, actions will be performed on the templates.

The document operations include operations related to working with documents (adding, deleting, editing). Operations are performed in the directory.

The folder operations include operations related to working with folders (delete, create, set access level). The admin can perform basic actions with folders and also set folder access level for users based on their position.

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**Fig. 1.** Organizational use case diagram for EDCS

**Fig. 2.** Diagram of incoming document processing activities
5 Conclusion

In conclusion, the development and implementation of an electronic document circulation system is a good practice for organizations, as it helps to improve management efficiency. A comparative analysis of existing electronic document circulation systems showed that it is possible to choose one of the current EDCS for different enterprises, but these systems do not take into account the specific characteristics of a particular organization.

Modeling is an important step in the creation, further development and application of EDCS in the work process. Modeling allows you to review the system and its logic before the main development work begins, which saves time and money later if errors are detected at the initial stage of modeling.

During the analysis of existing electronic document circulation systems, their strengths and weaknesses were identified. Strengths include automating processes, speeding up document processing, increasing data accuracy and reliability, and reducing paper and document storage costs. However, some weaknesses were also identified, such as the complexity of system implementation, the need for staff training, and potential data security issues.

The article also considers the procedure for working with the electronic document circulation system in the cargo transportation processes of the railway. This procedure includes the following steps: creating an electronic document, sending and receiving it, checking and processing, storing and archiving. Each of these steps is examined in detail and recommendations for process optimization are offered. An electronic document circulation system has been developed that can be applied to railway cargo transportation processes. The implementation of such a system allows to increase the efficiency of moving and processing documents, reduce the time and costs of processing paper documents, as well as improve the accuracy and availability of information.

The results of the work can be useful for railway companies interested in optimizing document circulation and administrative processes. The implementation of the electronic document circulation system can lead to significant improvements in performance and cost reduction, as well as increase the company's competitiveness in the shipping market.

References


