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THE INTELLIGENT INFORMATION AND MANAGEMENT SYSTEMS: POSSIBILITIES AND PROSPECTS OF APPLICATION IN RAILWAY TRANSPORT

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Abstract

The article considers the concept of intelligent information and management systems, as well as the possibilities of their application in railway transport in the field of organizing the transportation process, as well as reserves for increasing the efficiency of production and economic activities of railway transport enterprises, consisting in the current digital transformation of the transport industry (implementation of artificial intelligence elements at various stages of organizing the transportation process in railway transport). At the same time, it is important to be able to assess the effect obtained from the introduction of multi-level intelligent information and management systems by assessing through economic and mathematical modeling and, as a result, assessing the potential savings in operating costs. The introduction of intelligent management systems in organizing the transportation process at railway enterprises will ensure the required volume of incoming and outgoing information flows, and therefore provide the necessary "working" information of the appropriate volume and quality to specialists of various services and enterprises.

Keywords: digitalization, artificial intelligence, rail transport, information flows, automation of the transportation process.

ИНТЕЛЛЕКТУАЛЬНЫЕ ИНФОРМАЦИОННО-УПРАВЛЕНЧЕСКИЕ СИСТЕМ: ВОЗМОЖНОСТИ И ПЕРСПЕКТИВЫ ПРИМЕНЕНИЯ НА ЖЕЛЕЗНОДОРОЖНОМ ТРАНСПОРТЕ

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Реферат

В статье рассмотрено понятие интеллектуальных информационно-управленческих систем управления, а также возможности их применения на железнодорожном транспорте в области организации перевозочного процесса ,а также резервы повышения эффективности производственно-хозяйственной деятельности предприятий железнодорожного транспорта, заключающиеся в актуальной цифровой трансформации транспортной отрасли (внедрения элементов искусственного интеллекта на различных этапах организации перевозочного процесса на железнодорожном транспорте). При этом важно иметь возможность оценить полученный эффект от внедрения разноуровневых интеллектуальных информационно-управленческих систем путем оценки посредством

экономико-математического моделирования и, как результат, – оценки потенциальной экономии эксплуатационных затрат. Внедрение интеллектуальных управленческих систем в организации перевозочного процесса на предприятиях железной дороги позволит обеспечить требуемый объем входящих и исходящих информационных потоков, а значит обеспечить необходимой «рабочей» информацией соответствующего объема и качества специалистов различных служб и хозяйств.

Ключевые слова: цифровизация, искусственный интеллект, железнодорожный транспорт, информационные потоки, автоматизация перевозочного процесса

Introduction

The economic and technological development of social systems in the modern world can be characterized as the initial stage of the functioning of the sixth technological order. Its essence lies in the fact that microelectronic components occupy key positions in it. At the same time, its dynamic evolutionary development is ensured not only by the widespread distribution and implementation of various variable modifications of computing equipment in all areas of life, but primarily by the active use of Internet technologies and cloud technologies. The growth of the importance and value of information, as well as the widespread use of personal portable communication devices of various specifications at various levels of management, along with the active development of the digital economy, is an evolutionary stage in the development of digitalization. The comprehensive penetration and expansion of the influence of digitalization at all levels of the public administration system and the national economy and, as a consequence, the increase in the volumes of data required in production, the collection and analysis of which form the basis of digitalization processes, makes it necessary to move to a more advanced set of information processing tools that ensure the implementation of characteristic functions and tasks at all management levels (both at the macro and micro levels), including not only material production, but also the service sector. Achieving this result is possible through the use of intelligent control systems of various kinds, which are unique systems capable of not only analyzing, but also understanding and recognizing changes in the objects under study and the external environment that affect the object and the operating conditions of production and transport systems, formulating reasonable conclusions and, ultimately, an analytical report. At the same time, intelligent systems include as a functional feature the ability of autonomous intelligent technological self-learning in the process of their functioning, as well as diagnosing and predicting the development and behavior of elements of the transport system as a controlled object on the one hand and as a control system on the other hand.

Main part

A large number of studies and developments over a long period of time have been devoted to the study and application of various types of intelligent products at different stages of management activities (from the direct organization of technological processes to organizational and managerial processes) both in production and in transport and transport and logistics systems. This allows us to confidently trace the evolutionary nature of the development of approaches to the creation, digitalization and increase in the technological efficiency of information systems, as well as the

construction on their basis of technical and technological and economic and mathematical models characterizing the entire system of organizing the transport process. The works of D. Bell, M. Wiener, A. Turing, D. Marcellus, D. Naisbitt, M. Castells are devoted to the problems and prospects of introducing intelligent systems into production processes [1]. Along with this, quite large-scale studies were conducted on the possibilities of implementing and updating modern artificial intelligence technologies in various spheres of human activity. Today, the integration of artificial intelligence and its element-by-element application in various parts of the organization of the transportation process is no longer surprising. In railway transport, the organization of transportation work is a complex systemic process that includes a large number of elements and relationships between them (including physical elements - individual railway transport enterprises and infrastructure components). It should be noted that considerable attention is paid to the characteristic and specific features of data storage and processing, technologies using intelligent algorithms: virtual and augmented reality, the Internet of things, cloud technologies, blockchain, etc. At the same time, it should be noted that the current stage of digital transformation processes is penetrating into an increasing number of spheres of the national economy. Therefore, the transport industry is no exception, but rather the opposite - it carries the potential for priority digital development, since it is here that new challenges arise, the need to improve logistics management processes and financial and information flows. Forecasting and predictive analytics technologies have the greatest potential for application in the transport sector. The already existing accumulated volume of information data in the context of structural divisions of transport of various operational focus can be used to assess the condition of the assets in operation, identify reserves and prevent threats that lead to unplanned failures and disruptions in operation, record the probability of failure and the remaining resource in real time. In practice, these measures will reduce equipment operating costs, advertising costs and significantly increase the competitiveness of transport enterprises [2]. The use of artificial intelligence as a significant element of industry intelligent management systems, as well as socio-economic and production-labor systems includes such relevant elements as unmanned high-speed trains, the introduction of "Smart Cities" systems. These concepts are based on the model of so-called “digital twins”, containing a set of structured data on the appearance of an object, its functions, condition, external interventions, structural and qualitative characteristics, and much more. It allows for the most accurate prediction of the state of an object when an emergency situation occurs [3].

The relevance of using modern intelligent systems in the transport sector is primarily due to the comprehensive role of transport, covering all levels of state functioning. That is why intelligent railway systems of various levels and applications are becoming increasingly common in the practice of multi-level production and economic systems. It is important to note that railway transport is a complex multi-level dynamic system with many factor parameters and resulting performance indicators, characterized by a strict hierarchy of building relationships in the organization of operational work. In this regard, it can be assumed that the introduction and subsequent development of artificial intelligence technologies holds significant promise and can bring a number of the following effects:

• new opportunities for improving and updating the management system and organization of operational work of the railway as a whole, its divisions and transportation processes, which would reduce operating costs; • implementation of a program to optimize the carrying capacity of sections, improve the system for ensuring the safety and reliability of transportation, the introduction of unmanned rolling stock, intelligent management of the railway infrastructure, which would reduce fuel costs and payment for the work of locomotive crews;

• obtaining operational information about the operating mode and the occurrence of failures of technical equipment, their remaining life, optimization of repair cycles, ways to reduce energy consumption and save other resources, which would reduce the material costs of structural divisions of railway transport [4].

To obtain a common result, these effects can be combined by defining a complex indicator that includes the product of the corresponding functions characterizing each type of effects that can be obtained. In general, a complex indicator of the effectiveness of the use of an artificial intelligence system in organizing rail transportation can be presented as follows:

$$K_{inti} = \prod_{i=1}^{n} f_i,$$

where K_{inti} – is a complex indicator of the effectiveness of the application of the artificial intelligence system; f_i – are functional dependencies (their calculated results) characterizing the individual effects from the implementation and use of the artificial intelligence system, i – is the number of significant effects from the implementation and use of the artificial intelligence system.

It should be noted that the functional dependencies characterizing the individual effects of the implementation and use of the artificial intelligence system should take into account all factors reflecting: updating the management system of railway divisions and transportation processes, as well as the organization of operational work, optimization of the carrying capacity of sections, improvement of the system for ensuring the safety and reliability of transportation, the introduction of unmanned rolling stock in passenger, freight traffic and shunting operations, intelligent management of the railway infrastructure. The calculation of this complex indicator can result in the determination of a real economic effect expressed not only in the potential for reducing costs, but also in real savings in the costs of servicing rolling stock, infrastructure and the organization of the railway transportation process as a whole. It is important to note that obtaining this effect becomes possible in the case of using a technology based on the creation of a developed system of client places that allow input, primary processing of information directly at the places of its origin with further transfer of information to a single database. For example, with the timely formation of detailed reports on failures of automation, telemetry and communication devices, malfunctions, train stops due to the occurrence of emergency situations of various kinds for an arbitrary period and for an arbitrary parameter, we can talk about the emergence of the ability to identify typical malfunctions and their causes in the operation of devices, as well as speed up the search for their causes and take timely measures to prevent failures. The use of intelligent information flow management systems in the field of operational work of transport enterprises would make it possible in the future to automate the process of monitoring and managing objects in various sectors of the national economy [6].

In the case of the introduction of a system of this type at railway enterprises, it would be possible to ensure the required volume of information flow at the input and output, and therefore provide information of the appropriate quality to specialists of various services and enterprises. The creation of a unified information and management base used for recording and analyzing failures in devices of various operational nature would reduce the time and labor costs for processing this information, thereby activating the resource potential in the area of saving operating costs in various areas of railway transport.

Conclusion

In conclusion, it should be noted that the introduction of digital technologies in the field of railway transport, in particular the creation and use of updated information and management systems, is due to the need to automate the management of transportation processes, increase the safety of the transport system, as well as the need to optimize the main operational processes by automating the process of accounting, planning and management of railway resources. This requires ensuring control over the reliability of the entered data, updating them and maintaining the confidentiality of the information used. The capabilities of artificial intelligence carry great potential in the case of their actual application in the field of railway transportation, allowing to increase their safety, as well as managerial and economic efficiency.

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