DOI 10.52209/1609-1825_2022_4_258 UDC 656.681:3

# Automation of Production on Railway Transport

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***Abstract.*** *Discusses the information management system of railway transport, including information on the current status and location of the rolling stock, the needs of all participants in the transportation process. It justifies the idea that a unified intellectual system of management and automation of production processes in railway transport will allow the development of new planning and control tools based on digital technologies. Consideration is given to the possibility of an employee receiving a job for a mobile workplace, determining the location using satellite navigation and recording the fact that the task has been completed. This solution will increase the efficiency and quality of work. The authors conclude that an intelligent transport system will provide the necessary level of management coordination. The article reveals the integrity of the formation of multimodal services, the principles of the implementation of «one window». The authors focus on the need to introduce a single transportation document using EDS for their registration. It is necessary that the transportation document in electronic form simultaneously arrived at the customs authority and at the intermediate station.*

***Keywords:*** *intellectual transport, information system, transportation management, transportation process, digital technology, automated system, business models.*

**Introduction**

The development of information technologies of the transportation process and automation of technological cycles, business processes of railway transport allows for door-to-door transportation. Increasing the availability and expanding the functionality of information technologies in production is an advantage of information technologies while ensuring the technological and economic interests of the industry. The most priority tasks arising from the equipping of automated workstations (APMs) of the points of execution of contracts for transportation at mass loading stations, the implementation of automated control systems at sorting, freight stations and with neighboring railway administrations, the introduction of information systems, automating functions and management processes, as well as the provision of information services to the clientele are considered here. In scientific work it is necessary to consider the introduction of a unified intellectual system of management and automation of production processes in railway transport. In the dissertations of Alibekov Bayrambek Isaevich, a methodology for the organization of transport production and management of railway junction facilities based on an integrated approach to modeling and decision-making based on the principles of logistics-oriented and balanced development and interaction was developed and substantiated. On this basis, nonlinear dynamic models of network planning are formulated and effective methods for their solution are developed [1].

**The technique.** In conducting this study, statistical information was collected on the duration of individual technological operations, the evaluation of static data and the analysis of their descriptive characteristics. In determining the effectiveness of the proposed measures, the methods of an automated operational management system for freight traffic were used, integrating all the information on the progress of the transportation process of the interconnected modules of all the objects participating in it. A general block has been developed – a scheme for the information activity of a cashier. This allows you to transfer a number of technological processes to a fundamentally new level, contributing to the formation of a single information space for freight traffic. A method of servicing applications in the QS at the Poisson incoming flow and exponential service time for the conditions of use in railway transport is proposed. The scientific novelty of the research consists in:

- development of synergetic approaches to the use of information technologies in railway transport and to improve automated workplaces for processing transportation documents in railway transport.

- development of a methodology for creating an information network and a bank of a railway junction, where the clientele of the serviced zone should be connected under certain conditions;

- development and justification of evaluation criteria of the «shipper-consignee» system for the implementation of the electronic consignment note system;

- theoretical substantiation of a rational system of information support for the escort of transported goods by wagon shipments;

- feasibility study of the operational implementation of automated workstations of commodity cashiers in electronic document management [2].

**Practical significance.** The results are used to generate a list of activities aimed at the introduction of intelligent rail traffic management systems.

The creation of intelligent rail traffic management systems and smart railway should be the main focus of infrastructure. The introduction of such systems on the entire network is not a matter of one day. The information management system of railway transport will allow collecting and analyzing information on the current status and location of the rolling stock, the needs of all participants in the transportation process, will take into account the infrastructure capacity. This will make it possible to implement one of the main principles of the digital business model – online business, ensuring the efficiency and relevance of information for quick decision making in the field of traffic and infrastructure management. We are talking about the introduction of an automated system for the operational management of freight traffic. The system integrates all information on the progress of the transportation process of the interconnected modules of all objects participating in it. This is information about trains, locomotives, locomotive brigades, wagons, containers with the reflection of data on their location, condition and basic technological operations. The operational work, data of operational plans, restrictions on the infrastructure of JSC «NC KTZ» are taken into account. That is, the system provides management of operational work on the basis of information on all objects involved in the transportation process [3].

At JSC Russian Railways, about 2.2 million input messages are processed by the system every day, 6 million output messages are generated and 50 million requests for receiving information are received. As part of the Digital Railway program, Russian Railways developed an electronic marketplace Freight Transport. This is a unique service where shippers can order transportation in the rolling stock of various owners from any point where there is access to the Internet, and immediately pay for it. In addition to ordering a car and transportation services, the services of loading and unloading and warehousing are available on this site. The introduction of a unified intellectual system of management and automation of production processes in railway transport will allow the development of new planning and control tools based on digital technologies. We are talking about planning systems for the supply of material and technical resources, financial planning, and integration with mobile workplaces of field personnel. That is, the employee receives a work assignment for a mobile workplace, determines the location using satellite navigation and records the fact of the assignment. Such a solution will increase the efficiency and quality of work [4].

Thus, «digitalization» has become a global process, which to some extent covers almost all countries, almost all industries, including railway transport. The enormous potential of digital technologies in organizing the transportation process, maintaining the infrastructure, and increasing the attractiveness of services for passengers and cargo owners is obvious.

A major role in improving the efficiency of operations is the transformation of technological processes. Opportunities to improve the performance of rolling stock, including traction, are considered on an ongoing basis. In this area, the technological processes of all critical stations and nodes have been revised, as a result of which the technological time has been achieved for the performance of freight train processing operations and the length of service of locomotives has been extended [5].

The work on lengthening the shoulders of the service will be continued in stages. So, first of all, it is planned to organize the passage of freight trains at the site from the Shymkent station to the Zhambyl station with the exception of parking at the Tulkubas station and at the site from the Shu station to the Almaty station without stopping at the Otar station. These activities will free up the fleet of locomotives and cars, reduce downtime and speed up the speed of the rolling stock. The mission of transport is to deliver goods from senders to recipients just in time. Involving the services of railways to solve particular problems, we need methods for modeling and managing development trends of the entire transport industry. Analysis of the operational work of the station of Jana Karaganda showed that due to the lack of an application and underload, the cars are idle. To provide information on the availability of rolling stock, it is necessary to automate the cargo and commercial operation of the station.

According to the station of Jana Karaganda, loading of cars – with the plan of 428/12845 cars (in the numerator – average daily indicators, in the denominator – absolute) – the actual performance was 421/12634 cars, which is 7/211 cars less than the set task (by 1.6%).

In comparison with November 2017, loading decreased by 87 wagons daily (11.1%).

The main reasons for the failure of the loading plan and the decline in performance in comparison with the year 2017:

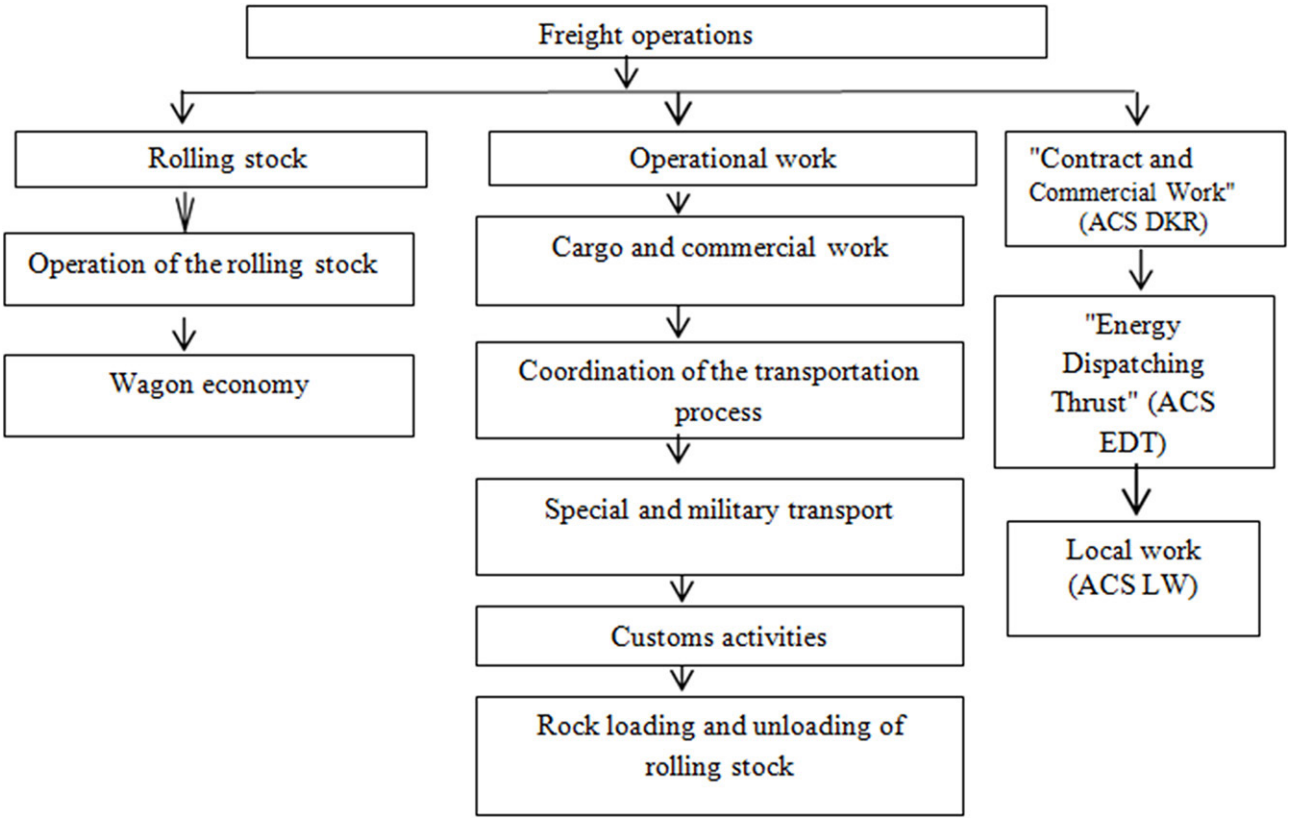


**Figure 1 – The structure of the freight transportation process**

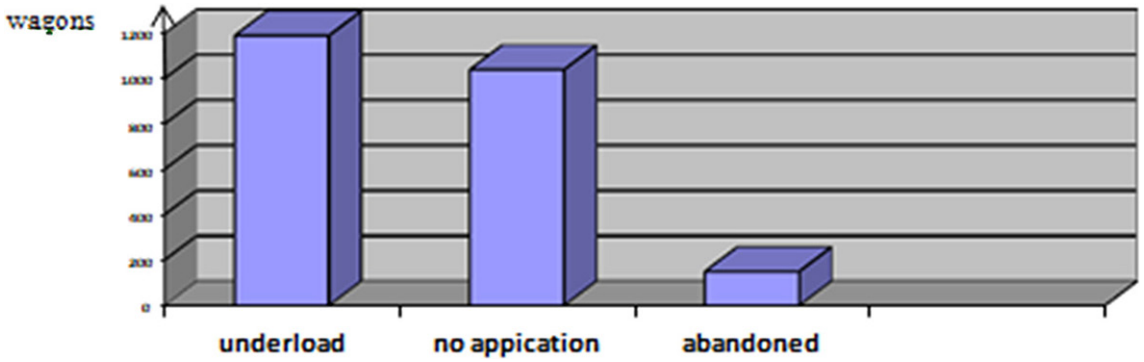


**Figure 2 – JSC «Arcelor MittalTemirtau» main reasons for non-fulfillment of the loading plan**

Coal:

- JSC UD «Arcelor MittalTemirtau» – underloading amounted to 1,190 wagons – 69,125 tons, of which the lack of an application – 1,040 wagons – 58925 tons and refusal by 150 wagons – 10,200 tons for Uglerudnaya.

- KarUgolgroup LLP – loading plan for 40 cars – 2600 tons transferred to Karaganda Sorting Station.

- Komir Kuat LLP – no application for 37 cars – 2533 tons for Agadyr, a fine for 4 cars – 276 tons.

- Sat Komir LLP – no application for 39 cars – 2,691 KZH, a penalty for 11 cars – 759 tons.

Flour: ZK Sunkar and K LLP – no application for 5 cars – 320 tons for Ashgabat, 15 cars for 975 tons for Afghanistan, 3 cars for 192 tons – fine.

For 11 months of 2017 at the railway station of Karaganda, loading of cars – with the plan of 424/141660 cars (in the numerator – average daily indicators, in the denominator – absolute) – the actual performance was 390/130132 cars, which is 34/11528 cars less than the set task (by 8.0%).

Compared to 11 months of 2018, loading decreased by 80 wagons daily (17.0%).

Coal: JSC UD Arcelor Mittal Temirtau – no application for 5,610 wagons – 375,870 tons, refusal for 4,303 wagons – 2,88301t for Ugluardnaya.

- Nefrit LLP: 33 cars – 1,550 tons – no application, due to the lack of a contract in the month of January, refusal for 18 cars – 526 tons by appointment to Art. Myrza.

- Splav Transz LLP – no application for 1923 cars

– 128840 tons, 157 cars refused – 9536 tons in January due to the lack of a contract.

- Transkomir LLP due to the absence of a contract in the month of January, the absence of an application for 170 cars – 11880 tons.

- Kaz Ferrit LLP – no application for 201 wagons – 13,414 tons, due to the lack of a contract in June, August.

- Karugolgroup LLP – the absence of an application for 150 cars – 10,000 tons, due to the refusal of the consumer from coal, in November the loading plan for 40 cars – 2,600 tons was transferred to Karaganda Sorting Station.

- Sat Komir LLP – no application for 331 wagons – 22,200 tons, consumer refusal of coal and no contract, a penalty for 11 wagons – 759 tons.

- Rapid Refusal LLP for 41 cars – 2,687 tons per Murzu, due to lack of payment, lack of an application for 15 cars – 985 tons, due to the refusal of the consumer from coal.

- Shanis LLP – the absence of an application for 57 wagons – 3800 tons per Murzu, due to the refusal of the consumer from coal [6].

Center Snab LLP – refusal for 5 cars – 325 tons to Iran.

Votprom LLP at Jean Aul, the absence of an application for 89 cars – 5340 tons, for a fine – 8 cars – 480 tons.

Flour:

- Sunkar and K LLP – for Afghanistan – no application for 229 cars – 14,600 tons due to lack of permission from Astana, for Uzbekistan – 43 cars – 2,752 tons, no application for 5 cars – 320 tons for Ashgabat, 8 cars – 640 tons – fine.

- «KazUzExport» is not confirmed from Astana for 36 wagons – 2273 tons for export.

- LLP «Eco Tera» no application for 85 cars – 5806 tons, due to its overestimation, 35 cars – 2380 tons due to the lack of confirmation of the plan from Astana.

To avoid the absence of an application, it is necessary to organize the transportation process with all departments – to coordinate with enterprises, customs authorities of border stations. It is necessary that the transportation document in electronic form at a time arrives at the customs authority and at the intermediate station. To envisage the improvement of transportation conditions for shippers by providing the best offer on the market for operating wagons. Optimize transportation costs through the further implementation of cost reduction programs with increased cost savings and optimization of flow distribution, taking into account the use of electrified paths and areas with the lowest load to reduce bandwidth requirements [7].

The establishment of analytical dependencies for determining the values of the flow parameters is of great importance for solving the problem. It is especially important to establish the value of the coefficient of variation, which depends on the magnitude of the coefficients of variation of the incoming flow and the duration of the service, as well as on the load on the service system [8].

Consider the General block diagram of the information activities of commodity cashier when solving all logical conditions, as well as operational tasks (Figure 4). The conditions for the operation of the QS are determined by a variety of factors, the most important of which are the average time that applications stay in the system and the service waiting time [9].

Indicators of the quality of service applications in the QS at Poisson incoming flow and exponential service time are determined by the following formulas:

Average waiting time of the request in the service queue:

$$t_{exp} = \frac{\rho \cdot (1 + V^2)}{2\mu \cdot (1 - \rho)}, \; t_{exp} = \frac{0,22 \cdot (1 + 20^2)}{2 \cdot 8 \cdot (1 - 0,22)} = 7,1 \text{ min}, \quad (1)$$

where $\rho$ – the utilization rate (load) of the QS;

$\mu$ – intensity of service;

$V$ – coefficient of variation of service time distribution

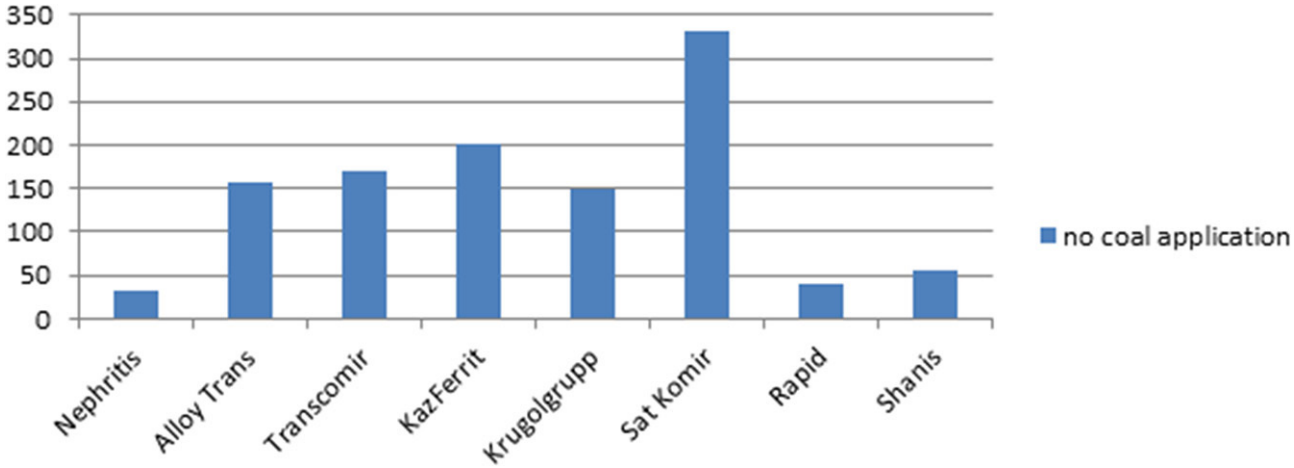


Figure 3 – No Coal Application

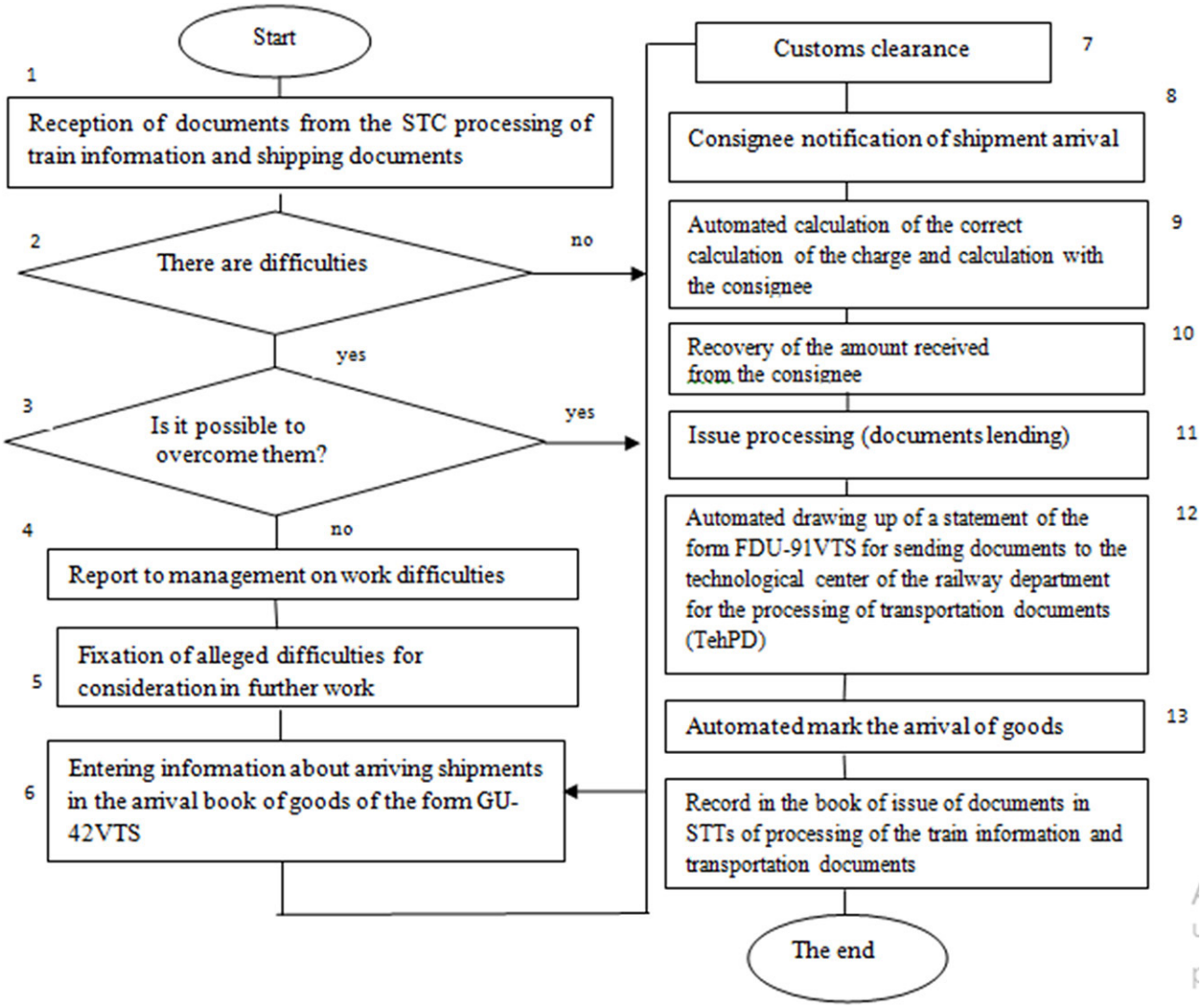


**Figure 4 – General block diagram of the information activity of the cashier**

$$\rho = \frac{\lambda}{\mu}, \quad \rho = \frac{1,8}{8} = 0,22, \tag{2}$$

where $\lambda$ – the intensity of the incoming stream or the average number of requirements per unit of time.

Average time of stay of the application in the QS:

$$t_{ave} = \frac{\rho \cdot (1 + V^2)}{2\lambda \cdot (1 - \rho)},$$
$$t_{ave} = \frac{0,22 \cdot (1 + 20^2)}{2 \cdot 1,8 \cdot (1 - 0,22)} = 31,42 \text{ min}. \tag{3}$$

Formalization based on the algorithmic recording of the content of commercial activities, the statistical probabilistic approach to the laws of fluctuation, the duration of elementary operations, loading and occurrence of a situation requiring management tasks, as well as evaluating the performance of the complex, form the basis of the situational algorithmic method for estimating its load [10, 11].

Improving the work involves the rejection of the use of forms of strict accountability. Unauthorized use of strict reporting forms is not allowed. The use of electronic legally relevant documents allows you to exercise control functions through EDS. Thus, it is advisable to withdraw the commercial acts and forwarding invoices of the GU-27 from the list of documents of strict accountability. Promising areas of improvement of technology work with the use of AS «Electronic transportation» are: refusal to execute GU-27 sending invoices; revision of the form and fullness of the carriage sheet on the basis of its modern technological tasks [12, 13].

Improving the technology of the transmission of notifications is another one of the most important areas of application of electronic document circulation. The need to send notifications is governed by the Charter of public railway transport and the Rules transportation of goods. Fixing the transmission of notifications allows you to correctly calculate the fee for the use of wagons or for storage of cargo. A significant technological problem is that for fixing two different notifications (about the arrival of cargo on station, on the upcoming filing on the access road) uses one book GU-2. Notification transfer possible.

On the arrival of the goods automatically upon the date stamp of the destination station in the

E-Carriage AS. A feature of the practical use of EDS is that EDS can be used as a tool that allows both to sign a document with the time specified in it and fix the moment of execution of any technological operation, which is especially critical for notifications [14, 15].

**Conclusions**

Operational work, data of operational plans, restrictions on the infrastructure of JSC «NC KTZ» and other aspects of the use of electronic legally significant documents in cargo and commercial work were considered. The most important directions for the implementation of a single intellectual management system and their interaction with consignors and consignees through the use of electronic legally relevant documents have been identified. The intelligent transport system will ensure the necessary level of coordination of management, the formation of the integrity of multimodal services and the implementation of the «one stop» principle, thus creating favorable conditions for the realization of the export and transit potential of the country. When preparing shipping documents, a lot of time is spent on incorrect and repeated input of information, in connection with this, the idle time of wagons at border stations increases. Therefore, it is necessary to enter a single shipping document using EDS for processing all the necessary documents.

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***Өнеркәсіп орындарында темір жол көлігінің автоматтандырылған жүйесі***

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***Аңдатпа.** Жылжымалы құрамның ағымдағы жағдайы мен орналасқан жері, тасымалдау процесіне барлық қатысушылардың қажеттіліктері туралы ақпаратты қамтитын теміржол көлігін басқарудың ақпараттық жүйесі қарастырылады. Ол теміржол көлігіндегі өндірістік процестерді басқару мен автоматтандырудың бірыңғай зияткерлік жүйесі цифрлық технологиялар негізінде жоспарлау мен бақылаудың жаңа құралдарын жасауға мүмкіндік береді деген идеяны негіздейді. Қызметкердің мобильді жұмыс орнына арналған тапсырманы алу, спутниктік навигация арқылы орналасқан жерді анықтау және тапсырманы орындау фактісін тіркеу мүмкіндігі қарастырылады. Бұл шешім жұмыстың тиімділігі мен сапасын арттырады. Авторлар зияткерлік көлік жүйесі басқаруды үйлестірудің қажетті деңгейін қамтамасыз етеді деген қорытындыға келеді. Мақалада мультимодальдық қызметтерді қалыптастырудың тұтастығы, «бір терезеден» іске асыру қағидаттары ашып көрсетіледі. Авторлар ЭЦҚ-ны пайдалана отырып, оларды тіркеу үшін бірыңғай көлік құжатын енгізу қажеттігіне назар аударады. Электрондық түрдегі тасымалдау құжаты кеден органына және аралық станцияға бір мезгілде келуі қажет.*

***Кілт сөздер:** интеллектуалды көлік, ақпараттық жүйе, тасымалдауды басқару, көлік процесі, цифрлық технологиялар, автоматтандырылған жүйе, бизнес-модельдер.*

***Автоматизированная система железнодорожного транспорта на производстве***

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***Аннотация.** Рассматривается информационная система управления железнодорожным транспортом, включающая информацию о текущем состоянии и местонахождении подвижного состава, потребностях всех участников перевозочного процесса. В нем обосновывается идея о том, что единая интеллектуальная система управления и автоматизации производственных процессов на железнодорожном транспорте позволит разработать новые инструменты планирования и контроля на основе цифровых технологий. Рассматривается возможность получения сотрудником задания для мобильного рабочего места, определения местоположения с помощью спутниковой навигации и фиксации факта выполнения задания. Это решение повысит эффективность и качество работы. Авторы приходят к выводу, что интеллектуальная транспортная система обеспечит необходимый уровень координации управления. В статье раскрывается целостность формирования мультимодальных услуг, принципы реализации «одного окна». Авторы акцентируют внимание на необходимости введения единого транспортного документа с использованием ЭЦП для их регистрации. Необходимо, чтобы перевозочный документ в электронном виде одновременно прибыл в таможенный орган и на промежуточную станцию.*

***Ключевые слова:** интеллектуальный транспорт, информационная система, управление перевозками, транспортный процесс, цифровые технологии, автоматизированная система, бизнес-модели.*

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