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Digital transformation of the transport industry: analysis of opportunities and risks

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Abstract. In the article, by analyzing the current state of the digitalization process of the transport industry and assessing the results of a survey of experts, the degree of impact of artificial intelligence on the business processes of companies is revealed.

The study of institutional and technological changes in the field of international transport corridors is reflected in this article. Information on the state and main trends of digital transformation of corridors is systematized, their ecosystem is analyzed, stakeholders and drivers of digitalization of the transport industry are identified. In this regard, the proper implementation of UN standards for the unification of infrastructure, digitalization of business processes to simplify transportation and transit requires the active participation of subjects of transport corridors.

The questionnaire developed by the authors of this article to survey the degree of impact of artificial intelligence on the operating technology of transport companies made it possible to assess not only the benefits of introducing artificial intelligence, but also possible risks.

Using SWOT analysis, the consequences of introducing artificial intelligence at both the micro-logistics and macro-logistics levels of companies' functioning were studied. Based on the studied data, the main directions of action that transport market entities should follow to increase the level of digitalization of the industry have been identified.

Keywords: *transport, transport industry, business processes, artificial intelligence, expert assessment, digitalization, transformation, multimodal digital transport corridors*

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Introduction

The rapid pace of digitalization development is opening up unprecedented opportunities to improve the efficiency of various industries and enterprises, including transport. Digital transformation of industries and the development of an innovative economy are integral components of achieving global competitiveness [1]. Digital transformation in the transport industry is aimed at improving the efficiency, safety, and convenience of transport systems and is trending towards growth [2-22]. So, in January 2024, at the next meeting of the World Economic Forum in Davos, the importance of digitalization was discussed. Almost 40% of the world's jobs are affected by artificial intelligence (AI), and in advanced economies, this figure rises to 60% [23].

In 2020, eight international organizations of the UN system, including the UN regional commissions – UNECE, UNESCAP, UNECA, UNECLAC, UNESCWA, as well as UNCTAD, ICAO and IMO, signed a joint statement "The contribution of international trade and supply chains to sustainable social economic recovery during the COVID-19 pandemic", which states that "... in an unprecedented situation where physical contact is not recommended, automation and digitalization are key factors contributing to the facilitation of trade and transport procedures" [24]. Therefore, international organizations of the UN system support the further digitalization of trade and customs procedures using global UN standards to ensure the fast and secure exchange of data and information on cargo and vehicles. Which corresponds to UN legal documents on transport, in particular, on the facilitation of transport and paperless trade [24].

Taking into account the above, the introduction of digital transport, transit and customs tools, especially along multimodal transport corridors, is the call of the time. Thus, the Joint Stock Company "National Company "Kazakhstan Temir Zholy" (JSC "NC "KTZ"), which is the backbone national transport company of Kazakhstan, is a provider of transport infrastructure services, including freight and passenger transportation, has been implementing 60 different projects and activities since 2019 within the modernization program "Digital Transformation" [25]. Although today NC KTZ JSC has more than 200 information systems, including the key ones: an automated system for operational transportation management, an automated station management system, an automated system for managing a group of stations united on a territorial basis, an automated system for commercial inspection of trains and wagons, automated control system for stations of the backbone network of NC KTZ JSC, automated workstation of an agent for cargo and commercial work, automated system for cargo and commercial work, etc. The general state of information technology (IT) is characterized by a low level of integration and coordination of information systems and databases, a high level of wear and tear of software and hardware infrastructure, the inability to collect reliable and complete data and analyze it, and long response times to business needs to implement the necessary changes (time to market).

An analysis of the systemic problems of the IT landscape of NC KTZ JSC (Company) shows that the digital core of the Company (a Set of high-quality key IT services and consistent data that ensures the continuity and efficiency of the Company's business processes) is outdated, which in turn is a barrier to industry development. In addition, the business processes themselves are being optimized; new participants in the transportation process have emerged,

including private carriers (passenger and cargo). There is a digital information interaction with stakeholders (other railway administrations, railway clients, government agencies, etc.), which in turn makes it possible to move to organizing transportation using paperless technology, supporting cooperation and healthy competition between railway transportation entities, and implementing a new project operating model of the Company, making management decisions based on prompt and reliable data.

The transition to digital multimodal transport corridors is becoming the key to creating an effective system of transport and economic relations and integration into world markets for landlocked and transit countries. The regional approach makes it possible to realize the benefits of digitalization for transport and trade, and quite quickly, giving impetus to business development and creating the prerequisites for attracting transit container flows to transport communications of the countries of the region.

There is a clear need for digital transformation in the operation of multimodal transport corridors, which should be carried out based on advanced technological developments and standards in close cooperation with the business community representing trade, IT and the transport sector. One of the striking examples of the implementation of AI is the project Digital Transport Corridors of the Eurasian Economic Union (DTC EAEU) [26].

Important indicators in the development of international transportation are ensuring high-speed standards for trains, quality of service, accelerated processing at the border and joint work with logistics platforms and transport companies in China and Europe. In 2023, the route speed of container trains in transit traffic in the direction of China - Europe was 775 km per day, the volume of container traffic was 20.5 thousand tons [27].

The above figure is only part of the data confirming the rapid growth of transport flows across Kazakhstan and the associated infrastructure. Therefore, Kazakhstan's transition to digital multimodal transport corridors in the third decade of the XXI (21st) century has become the key to creating an effective system of transport and economic relations and integration into world markets for landlocked and transit countries [35].

Within the framework of the EAEU, a clear action plan has been developed to create a system of digital transport corridors of the EAEU (hereinafter referred to as the DTC Plan). The DTC showcase project involves the creation of a digital infrastructure and the identification of technical solutions for the implementation of all DTC services [26]. This project is being implemented on the territory of all EAEU member states on the main routes of international transport corridors selected for services, taking into account the recommendations of the Board of the EEC Commission, including the railway route from the border of the Republic of Kazakhstan with the PRC through the territories of the Russian Federation to the western border of the Republic of Belarus with the Republic of Poland.

Thus, digital transformation has a significant impact on the development of such an important sector of the economy as the transport industry. Where all the main economic trends can be traced, and basic digital technologies are already used. At the same time, there are certain obstacles to the effective development of digital services. For example, there is no information integration between transport corridor systems, and there is no clear vision of the benefits and possible risks of the impact of AI on digitalization.

Based on the above, this study is devoted to the analysis and assessment of the state of digital services in the transport industry.

The object of research in this article is the transport industry.

The subject of this research serves as a digital integration process within the ecosystem of a multimodal transport corridor.

The purpose of the study is to analyze and evaluate the digital transformation of the transport industry

The scientific novelty of the study lies in the fact that:

– the main business processes of transport companies for the transition to digital transport corridors have been identified;

– an expert assessment was given of the impact of AI on the business processes of companies in the transport industry;

– the consequences of introducing AI at both the micro-logistics and macro-logistics levels of functioning of a company in the transport industry have been identified;

– a SWOT analysis of the impact of AI on business processes of transport industry entities was completed.

The methodology

A comparison of the functionality and effectiveness of existing information systems and digital services with best industry practices and modern technological trends was carried out using the method of comparative analysis and expert assessments. To determine the degree of impact of the introduction of AI on the business processes of companies participating in the multimodal transport corridor, the method of expert assessments was used. The sample size was 73 respondents, with a confidence level of 0.95.

SWOT analysis was used to assess the strengths, weaknesses, opportunities and threats of using AI in companies in the transport industry to develop a strategy for improving digitalization. Combining these methods will make it possible to obtain a comprehensive and well-founded understanding of the state of digitalization of transport corridors and identify ways to improve them to optimize the transportation process.

Findings/Discussion

In the course of this study, an analysis and assessment of the state of digital services of transport corridors was carried out. To ensure systematic and coordinated operation of digital services within the ecosystem of transport corridors of the EAEU, CTKs are being implemented. In particular, JSC NC KTZ carries out electronic data exchange according to UN/EDIFACT standards in international railway freight traffic with the Chinese Railways Group of Companies, Russian Railways JSC (Russian Railways JSC), Belarusian Railways, Azerbaijan Railways JSC, JSC "Uzbekistan Temiryullari" and SE "NC "Kyrgyz Temir Zholu" in the amount of the SMGS consignment note, CIM/SMGS, train transfer sheet and shipping documents in PARTIN format [27]. In particular, JSC NC KTZ carries out the transportation of private empty, loaded wagons

and containers in export-import traffic at the stations of JSC Russian Railways using paperless technology using an electronic consignment note.

The implementation of projects for a seamless digital corridor of an automated accounting system and contactless inspection of rolling stock, optimizing locomotive operating modes and fuel economy, at NC KTZ JSC is ensured through the implementation of AI algorithms from "Huawei" and "PSA". [37].

The introduction of a digital Global Transit Document (GTrDTM), based on blockchain technology, which makes it possible to create a digital customs transit network, optimizes logistics costs and increases container flows through a multimodal transport corridor.

The creation of a digital corridor within the framework of the Trans-Caspian International Transport Route (TITR), proposed by "KTZ Express" Joint Stock Company (a subsidiary of NC KTZ JSC) and Global DTC Pte Ltd is one of the stages in the implementation of digital global transit [27, 29].

As part of this study, an expert survey was conducted to determine the degree of impact of AI on the digitalization of the transport industry. The expert group answered eight questions, each of which contained several statements revealing the impact of AI implementation on companies' business processes.

Analysis of the results obtained shows that AI will speed up the processing of large amounts of data and relieve employees of transport and logistics companies from solving routine tasks. But this does not mean that AI will replace humans in effective trusting communication, empathy, moral awareness and ethical principles.

Experts noted the areas of influence of AI to a greater extent in terms of optimizing information during the transportation of goods, tracking, forecasting, automation and robotization, including when analyzing large volumes of data.

Experts see big risks in the problem of data security, ethical issues when making AI decisions, as well as depending on technology, which, if it fails, can lead to irreversible critical situations.

The most important components of efficiency from the use of AI in the economy, experts noted the optimization of resources, cost reduction and process automation, which will lead to a reduction in errors. In the policies of companies when introducing AI, experts note changes in the strategy for using and implementing technologies, training staff and improving customer service.

One of the popular technologies used in transport companies is the technology for processing and analyzing large volumes of data. Transport companies will more actively implement technologies for processing and storing big data to effectively use information about cargo, routes and customer preferences.

The study revealed that there are risks in the implementation of AI. In this regard, a list of resources is proposed for companies to decide on introducing AI into business processes:

– large amounts of data for training, as well as creating accurate forecasting and calculation models;

– high computing power for processing large volumes of data and executing complex algorithms;

– data storage and processing systems that accumulate, store and analyze large volumes of data;

– powerful data security system that prevents unauthorized access to confidential information;
– integration with other technologies used in the enterprise;
– education and training of employees who use AI in their work;
– highly qualified specialists capable of working with advanced technologies and implementing solutions to improve logistics processes;
– financial resources to acquire and customize AI systems to invest in developing technological value and recruit highly qualified specialists;
– global presence to serve clients in different parts of the world;
– reliable partnerships with other enterprises and organizations to use their resources and expertise to optimize logistics processes.

The current situation in the global transport market shows that for the development of high-quality, sustainable and reliable infrastructure of multimodal transport corridors, it is necessary to use electronic documents based on digital data exchange.

The implementation of digital services must be coordinated and systematic. In this regard, an Action Plan for the implementation of the ecosystem of digital transport corridors of the EAEU (hereinafter referred to as the DTC Plan) was developed within the EAEU [26].

Today, railway transport provides a service - electronic exchange of the railway bill of lading. In Kazakhstan, it is implemented in the ASU DKR.

NC KTZ JSC, with the aim of implementing the exchange of electronic data according to UN/EDIFACT standards in international railway freight traffic, has entered into Agreements [27, 36]:

– with JSC Russian Railways and State Enterprise NC Kyrgyz Temir Zholu in the scope of the SMGS (Agreement on International Goods Transport by Rail) consignment note, CIM/SMGS, information on the train composition and shipping documents, data on consignees in PARTIN format;
– with the "Chinese Railways Group" in the scope of the SMGS (Agreement on International Goods Transport by Rail) consignment note, CIM/SMGS, information on the train composition;
– with "Azerbaijan Railways" JSC and "Uzbekistan Temiryullari" JSC in the scope of the SMGS (Agreement on International Goods Transport by Rail) consignment note and information on the train composition.

In order to implement paperless technology, KTZ – Freight Transportation LLP has concluded an Agreement with Russian Railways JSC on the implementation of transportation of private empty, loaded wagons and containers using paperless technology using an electronic consignment note [27]. Within the framework of this Agreement, NC KTZ JSC carries out registration of transportation documents in export-import communications using paperless technology to Russian stations of Russian Railways JSC.

Transportation documents in the automated system of NC KTZ JSC are signed with an electronic digital signature of shippers and consignees. The legitimacy of electronic transportation documents for transportation with JSC Russian Railways using paperless technology is ensured by a Trusted Third Party, whose functions are provided by JSC National Information Technologies at the state level.

The results of issuing transportation documents using paperless technology for 2020 at the company NC KTZ JSC indicate an increasing trend towards switching to digital design (see Figure 1).

Figure 1. Registration of transportation documents using paperless technology in 2020
Source: compiled on the basis of data

For 10 months of 2023, the percentage of paperless transportation in the direction of Russian Railways for export transportation was more than 60%. In intra-republican traffic, the percentage of carriages issued using paperless technology was 99.6% [27].

In 2021, test transportation of goods (according to the agreed nomenclature and routes) was successfully carried out in the Belarus-Russia-Kazakhstan message using paperless technology based on electronic SMGS consignment notes. Based on the results of test shipments, the issue of expanding the geography of the use of electronic transportation documents in the Belarus-Russia-Kazakhstan traffic is currently being considered. [28].

Between JSC NC KTZ, JSC Russian Railways and the Belarusian Railway, Regulations were signed for conducting a pilot project for the exchange of electronic messages IFTMIN in EDIFACT format in the volume of the SMGS consignment note, containing information about the electronic nature of the transit declaration and information about the customs mark during the transit of goods, transported by rail along the transportation routes Dostyk-Brest-North and Altynkol-Brest-North [27, 36].

The implementation of this project will allow the railway carrier to check customs marks in its information systems to fulfill its obligations under the customs legislation of the Eurasian Economic Union.

NC KTZ JSC is tasked with expanding the geography of the exchange of legitimate electronic data with carriers of other states and increasing the completeness and quality of their exchange to a level that allows for the transition to transportation using paperless technology, which in turn will lead to improved cross-border throughput, acceptance measures to eliminate bottlenecks.

Thus, NC KTZ JSC announced the launch of: a “smart system” based on Huawei’s AI algorithms by 2025; together with the PSA company - a seamless digital corridor; scaling the project to introduce automatic accounting systems and contactless inspection of rolling stock (“digital framework”); e-Telegram notification exchange systems; systems for optimizing locomotive operating modes and fuel economy “Trip Optimizer”, etc. [27, 36].

As part of the development of trade and economic cooperation between the EAEU and the People's Republic of China (PRC), following the Order of the Eurasian Intergovernmental

Council "On the plan for the digitalization of freight rail transport in the interests of developing trade and economic cooperation between the EAEU and its member states, on the one hand," which entered into force, and the People's Republic of China on the other hand" have established short deadlines for the implementation of a phased transition to paperless technology for the transportation of goods by rail [32, 33]. From 2027, economic operators and all competent authorities in SPECA member states will begin to use electronic freight transport data from economic operators by relevant UN legal instruments and standards, including the UN/CEFACT set of standards. Data will be interoperable between industries and relevant modes of transport along the Trans-Caspian Transport Corridor (TCTC) to improve the efficiency of data exchange and the movement of goods across borders [31, 34].

Thus, a digital corridor will be launched within the framework of TCTC. The declaration on the launch of this project in 2024 was announced by KTZ Express JSC and Global DTC Pte Ltd (Singapore) [29].

The document provides for cooperation on the launch of a project for customs clearance of electronic transit of goods traveling by rail from the PRC to the EU countries through the Republic of Kazakhstan, as well as the implementation of joint measures to ensure the effective uninterrupted operation of the Tez Customs digital platform on TCTC [29]. The Tez Customs platform allows you to carry out a customs declaration of goods electronically for deliveries from China to Central Asian countries.

The results of the project to create an ecosystem of digital transport corridors will be:

– reduction of delivery times;

– reduction of time and costs for border crossings;

– refusal of paper documentation;

– eliminating the costs associated with corruption;

– lack of physical contact with personnel (customs, government control bodies) due to the digitalization of procedures that eliminate physical checks and temptations of corruption;

– reducing the impact on climate and environment;

– increasing the average speed of cargo delivery and reducing waiting times at the border, it reduces greenhouse gas emissions;

– attracting additional cargo flows.

The transition to digitalization and reduction of time for processing paper documents for all participants in multimodal transportation (road and rail carriers, forwarders, state control authorities, etc.) saves up to 4 days. In addition, the project will ensure not only the digitalization of transit, full traceability of cargo, containers and vehicles, but also reduce the risk of non-delivery of cargo in containers, and ensure the trust of the customs authorities of the countries through whose territory international transport is carried out.

Currently, a concept aimed at introducing a digital Global Transit Document (GTrDtm), based on blockchain technology, is being considered [30]. The transition to its use will optimize logistics costs and create the prerequisites for attracting additional flows of container cargo to the multimodal transport corridor and create a digital customs transit network (DCTN).

Thus, at present, the digitalization of key business processes in the railway industry is considered an objective necessity. This raises the question of the degree of trust in AI. This

problem is reflected in a questionnaire developed by the authors of the article for transport industry experts.

The criteria for selecting experts were the field of activity, work experience, position held and age of the respondents (Figure 2). The study involved 73 respondents (at a confidence level of 0.95) working in the transport industry of Kazakhstan, in particular in the Ministry of Transport of the Republic of Kazakhstan, JSC NC KTZ, the transport and logistics company GC SMG, the transport and forwarding company LLP "PORTO COM.", Kazakhstan Road Research Institute, etc. Of these, 54.5% are women and 45.5% are men aged from 20 to 60 or more years. The age group of the most active life phase from 20-50 years old, who expressed their expert opinion, amounted to 82%. In groups of 50 to 60 or more, 18% of respondents completed the survey.

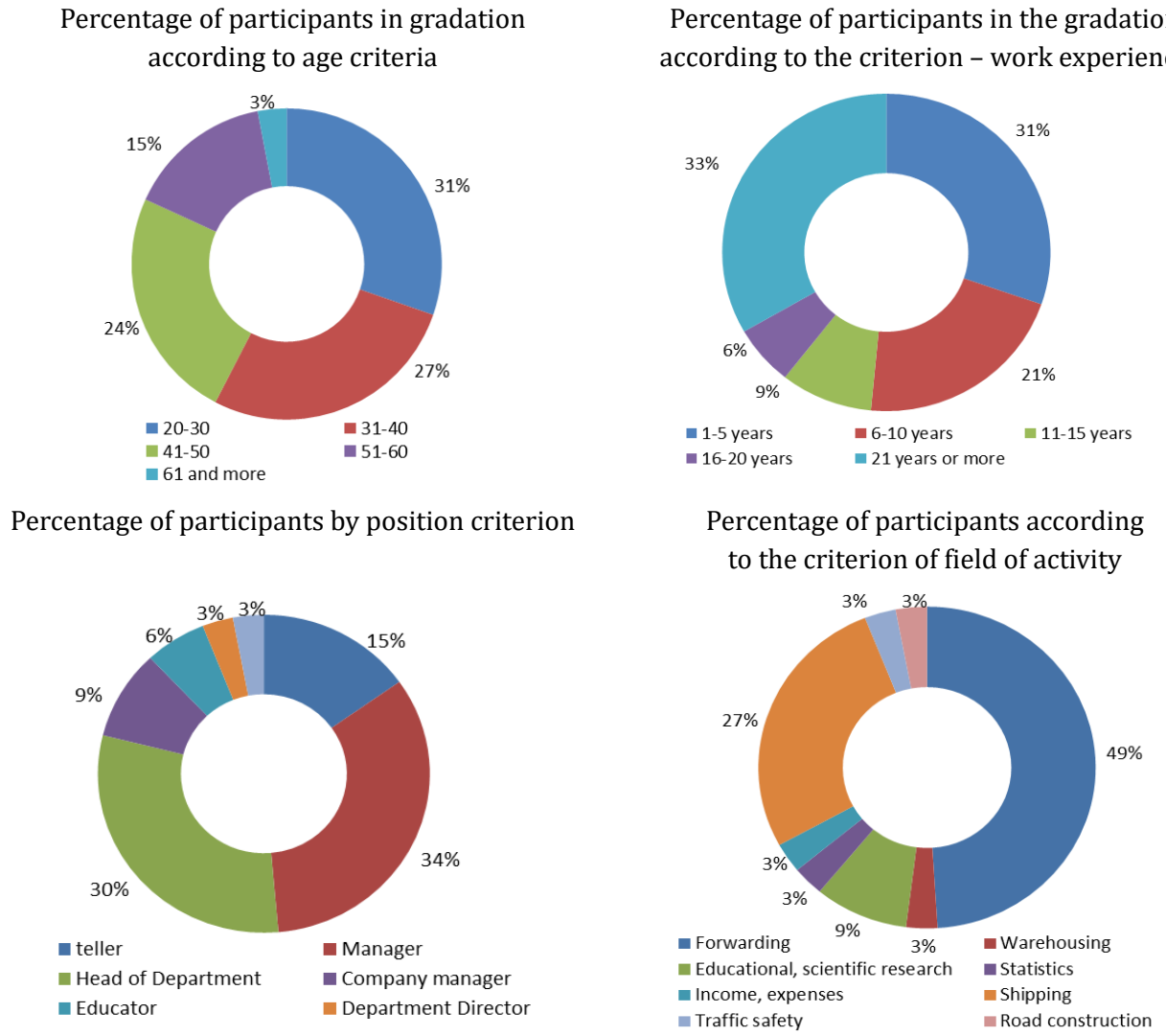

Figure 2. Criteria for Selecting Respondents

Source: compiled on the basis of the authors' own research

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The survey involved specialists from eight areas of transport logistics and eight different job levels, taking into account their work experience (see Figure 2).

Three key groups, to a greater extent, in terms of the number of respondents, filled out the questionnaire; they were experts with work experience of more than 21 years – 33.3%, from 1 to 5 years – 30.3%, with experience from 6 to 10 years – 21.2%.

When analyzing the experts' answers about what artificial intelligence does better than a qualified employee of a logistics company, it was noted that 72.7% of votes were given by participants in support of the importance of using AI in processing and analyzing huge volumes of data. This will make it possible to more accurately predict logistics needs, manage inventory and optimize routes (Figure 3).

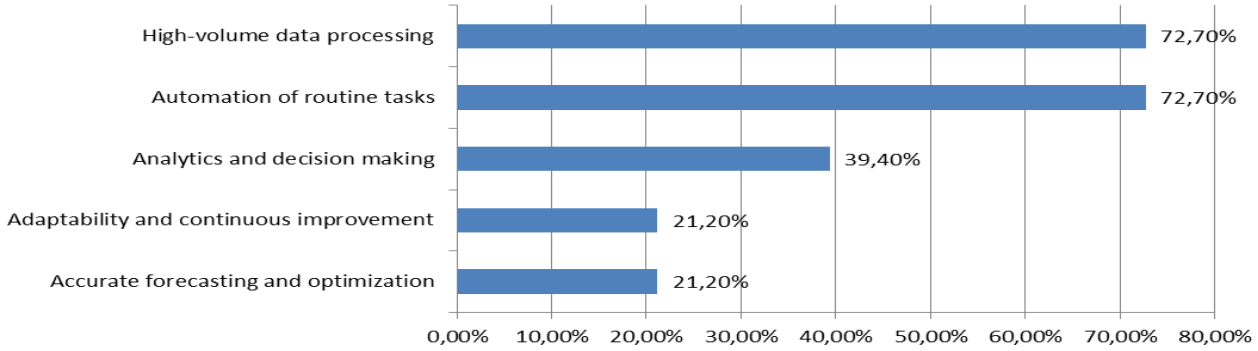

Figure 3. Analysis of expert preferences when comparing what artificial intelligence does better than a qualified employee of a logistics company

Source: compiled on the basis of the authors' own research

Equally important, 72.7% of votes were given to the statement that AI can automate many routine tasks, such as cargo tracking, routing, inventory management, and will make it possible to free up human resources to perform more complex and strategically important tasks.

The next most important statement was the statement, voted for by 39.4% of participants. AI can conduct deeper data analysis, identify patterns and provide logistics professionals with valuable information to make more informed decisions.

The remaining two statements showed that the company's employees are quite capable of handling this task on their own. Only 24.2% of respondents noted that the use of AI will help the company quickly adapt to changes in the environment and effectively respond to changes in the supply chain.

Also, with a difference of one vote, 21.2% of participants noted that machine learning algorithms in AI are capable of analyzing data and predicting future trends with high accuracy to optimize logistics operations, reduce travel time and reduce costs.

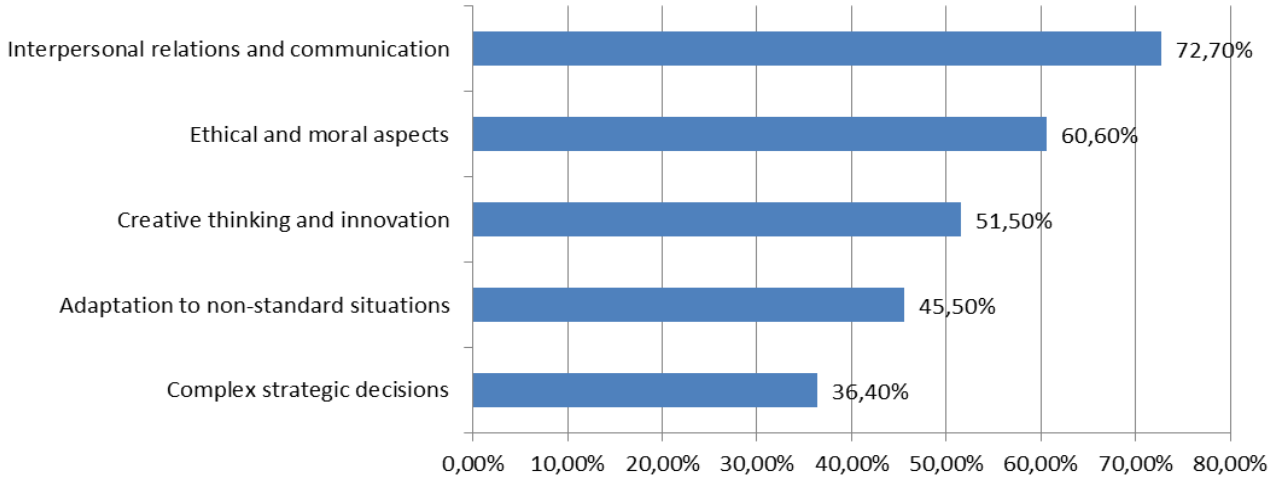

Figure 4. Analysis of expert preferences when comparing the reasons why a qualified employee of a logistics company will never be able to surpass artificial intelligence

Source: compiled on the basis of the authors' own research

Experts' preferences when comparing the reasons why a skilled logistics employee will never be able to outperform AI were divided, but the favorite was the statement that interaction with customers, suppliers, and other participants in the supply chain often requires human nuanced understanding, empathy and ability to communicate effectively. In this aspect, a person can better adapt to difficult situations and solve problems that require interpersonal skills. A larger number of respondents voted for him - 72.7% (Figure 4). 60.6% of participants noted that making decisions related to ethics and morality often requires human awareness and judgment.

The remaining three arguments were noted by approximately equal numbers of participants.

51.5% of participants believe that creative thinking and innovation are only subject to human abilities. In areas that require creativity and innovative thinking, humans are superior to AI. An example is the development of new strategies, change management, and the search for non-standard solutions to problems. In emergency situations that require a quick and flexible response to unexpected circumstances, a person may be more capable of adapting and making decisions in real-time. This opinion was expressed by 45.5% of experts.

According to the third argument, 36.4% of respondents agree with the situation, especially in conditions of uncertainty, human experience and intuition can be decisive factors in making strategic decisions, which cannot always be logically justified or inferred from data.

On the question of the potential of AI when used in the transport industry, it is clear that participants are more convinced of the predominant impact of AI on transport logistics.

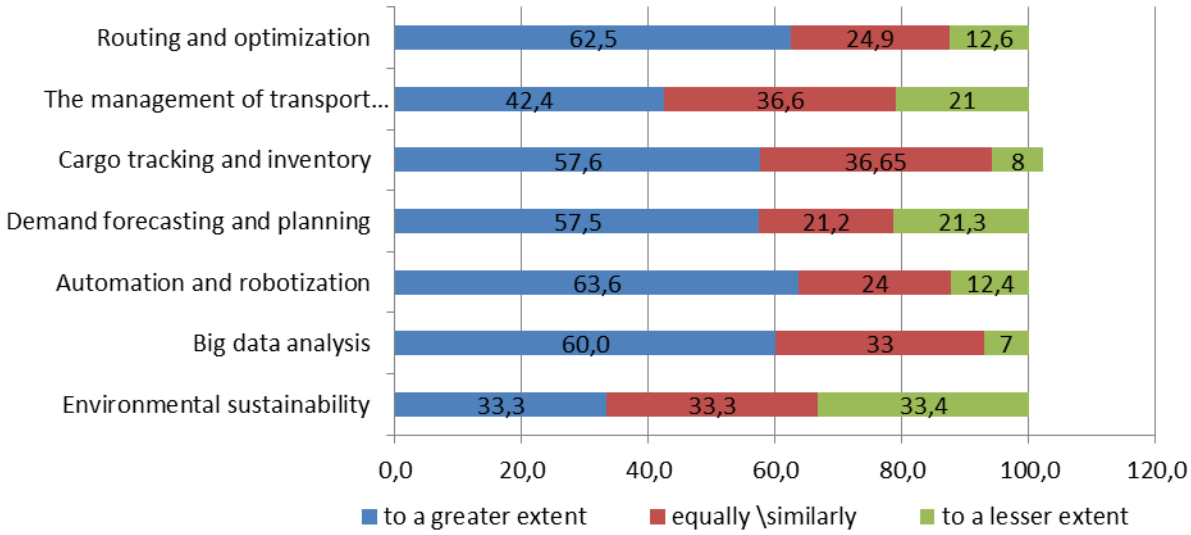

Figure 5. Analysis of expert preferences regarding the capabilities of AI when using it in the field of transport logistics

Source: compiled on the basis of the authors' own research

The experts were presented with seven stages of the transportation process. For all points presented, about 60% of respondents equally noted that the use of AI helps improve the efficiency of the company's business processes (Figure 5).

In the field of forecasting and rational operation of transport resources, only 42.4% of experts noted the importance of using AI. 36.6% believe that in this zone of influence, the human factor is effective and does not require the introduction of AI.

When it comes to optimizing routes and using vehicles to reduce environmental impact and improve energy efficiency, opinions are equally divided. Therefore, it is definitely not possible to single out this point as more or less reflecting the influence of AI on it.

To assess risks on a five-point scale, 7 statements were proposed.

The preferences of experts when assessing the risks of transport companies are distributed in increasing order of risk as follows:

– the use of AI in the transportation industry may raise ethical questions related to algorithmic decision-making. For example, liability issues for automated vehicles or the use of customer data;

– the introduction of AI can make companies more dependent on technology, and in case of failures or problems in the system, this can significantly hamper or stop operations;

– processing large volumes of data includes the risk of leakage or unauthorized access to confidential information about cargo, orders and customer personal data. Data protection becomes a priority to prevent leaks and privacy violations;

– In the case of automation of many processes using AI, some clients may face the problem of not being able to communicate with the operator in case of unusual situations or complaints (Figure 6).

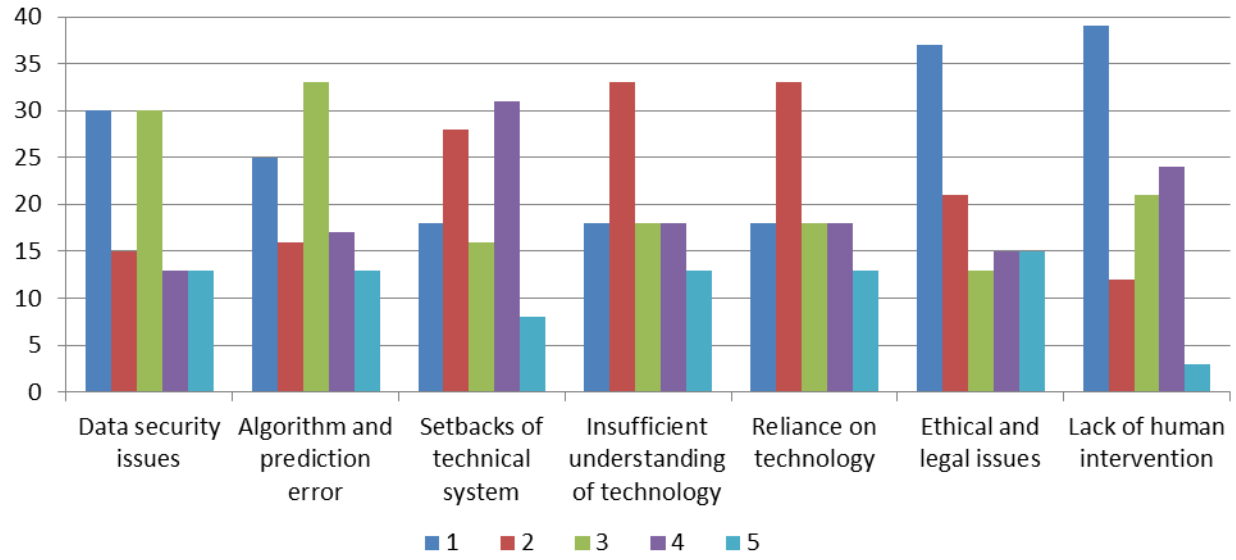

Figure 6.Analysis of expert preferences in considering the risks expected by customers when using AI in transport companies

Source: compiled on the basis of the authors' own research

All other situations did not cause respondents to fear a high degree of risk, but experts do not believe that they can be safe. The majority of respondents, from 27 to 33%, assigned these indicators a medium degree of risk.

Respondents include the following situations as such risks:

– AI is based on machine learning algorithms, which may be subject to error. Incorrect route forecasts, delivery time estimates or other errors may result in customer dissatisfaction and additional costs;

– technical failures, software failures or insufficient maintenance of AI systems may cause operational downtime, delivery delays and potential losses to customers;

– customers may face risks due to a lack of understanding of how AI works in transport logistics. This can cause mistrust and misunderstanding, especially if clients cannot explain the decision-making principles of the algorithms.

As part of this study, experts were asked to evaluate the degree of influence of AI on economic factors.

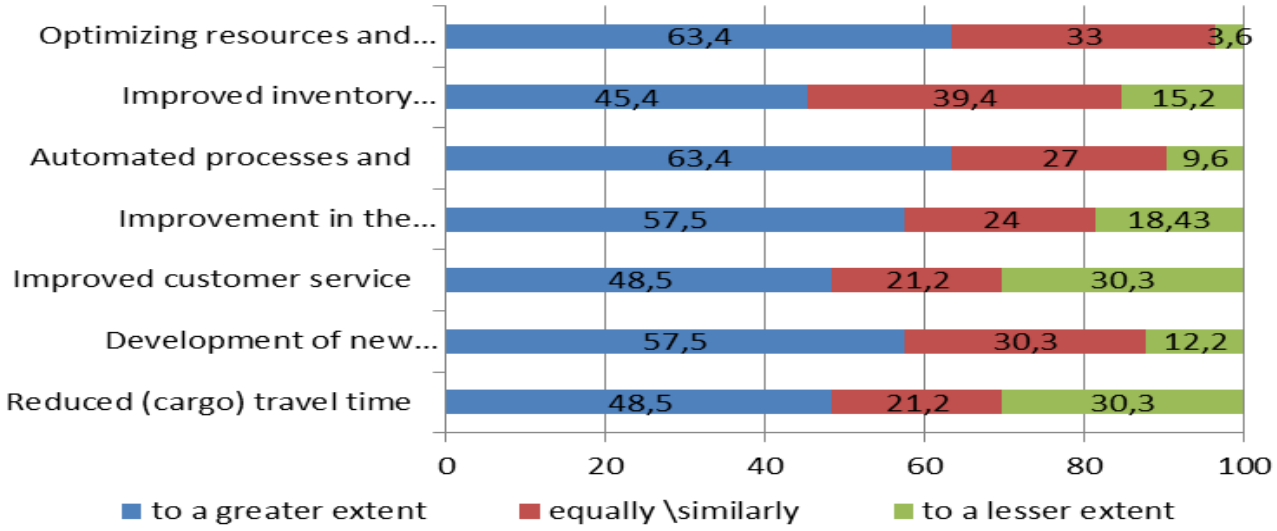

Figure 7. Analysis of expert assessments of the impact of AI on change enterprise economic factors
Source: compiled on the basis of the authors' own research

As a result of experts' assessment of the impact of AI on changes in economic factors of enterprises in the transport industry, it was revealed that from 50 to 64% of respondents in each statement noted that, to a greater extent, when using AI, the enterprise's economy tends to grow.

From 48.5 to 66% of experts indicate the great influence of AI on the politics and social environment of a harmoniously developing company, and in other cases, expert opinions were divided, almost equally, with an error of 3% (Figure 8). At the same time, experts note that environmental sustainability and ethical standards will not affect changes in company policies when introducing AI.

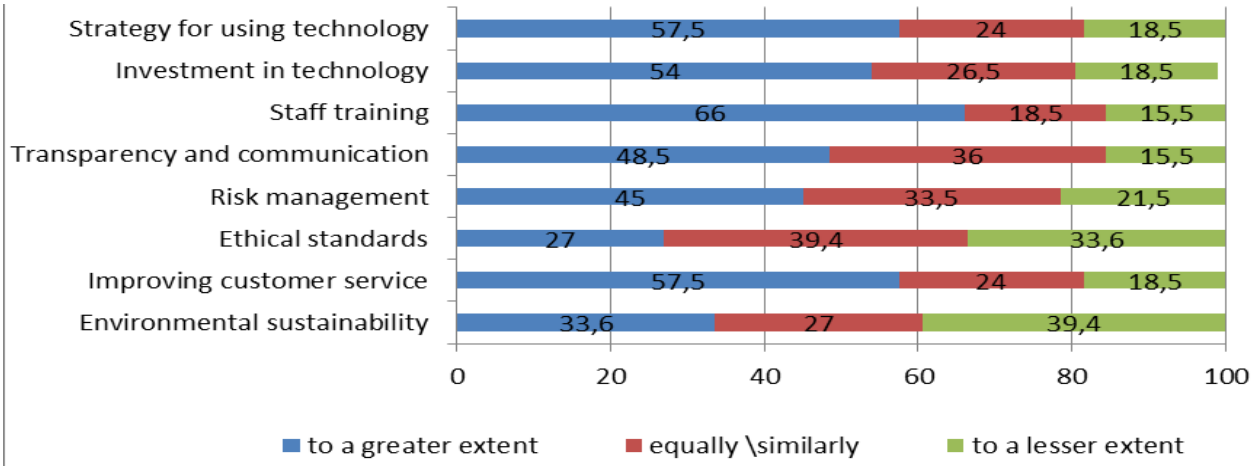

Figure 8. Analysis of the results of experts' assessment of changes in political factors of transport companies under the influence of AI
Source: compiled on the basis of the authors' own research

The largest number of experts (70%) noted the impact of AI on the functionality and qualifications of company employees.

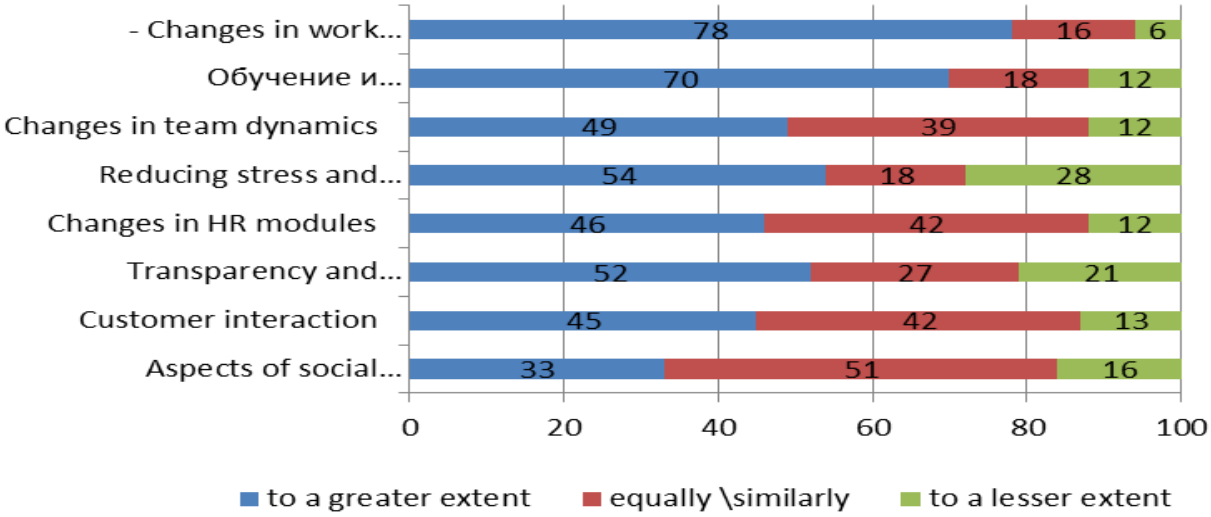

Figure 9. Analysis of the results of experts' assessment of changes in social factors of transport companies under the influence of AI

Source: compiled on the basis of the authors' own research

In aspects where AI can help companies begin to pay more attention to social responsibility issues, such as ethical standards, impact on employment, respondents (51%) are more doubtful and confident that social responsibility will remain at the same level.

From 45 to 54% of experts noted the insignificant impact of AI on the social factors of companies: changing the dynamics of team interaction; automation of routine tasks; review of personnel management models; emphasis on transparency in algorithmic decision-making; and changing the interaction of companies with customers.

Experts were asked to determine the degree of influence of AI on all business processes of enterprises at the micro and macro levels (Figure 10). When assessing the impact of AI on the technologies used by companies, 82% of experts considered Big Data technology to be the key technology among those listed.

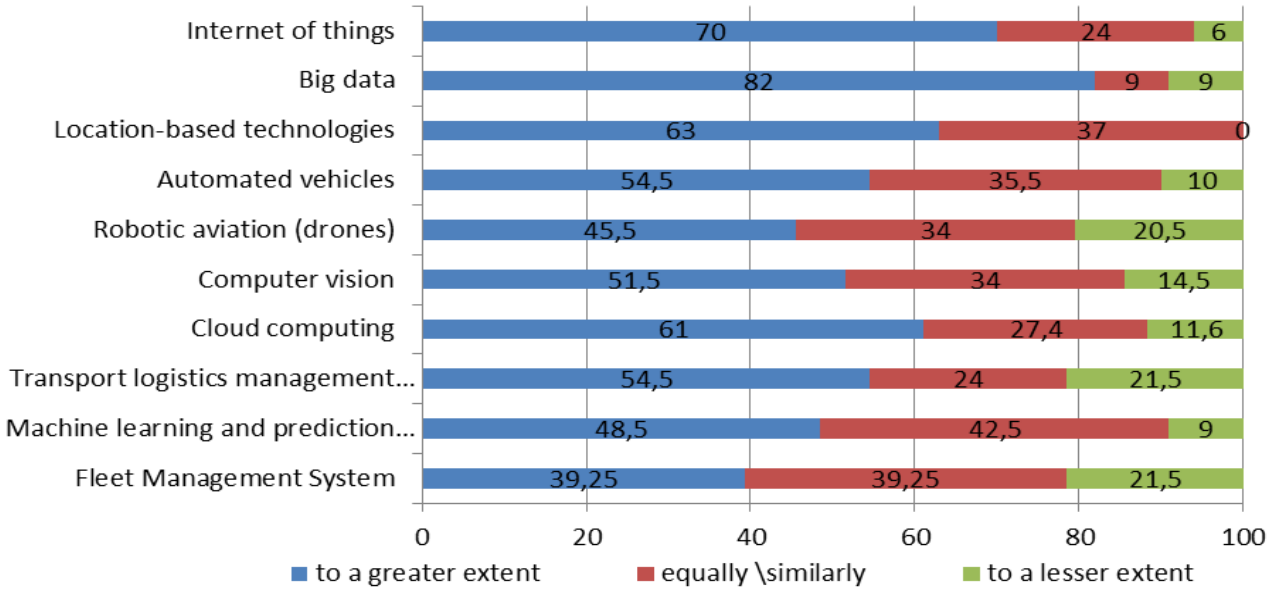

Figure 10. Diagram of AI impact assessment results on technologies used by companies

Source: compiled on the basis of the authors' own research

More than 60% of respondents chose to use cloud technologies to a greater extent by companies, as they provide high scalability and availability.

More than 46% of experts claim that the introduction of AI will have a greater impact on the development of automation, robotization, digitalization and monitoring of business processes.

Vehicle management systems that will provide more accurate maintenance planning, fuel management and maintenance optimization have not found much acceptance among experts. Opinions were divided, with 36% noting that AI will impact technology, but also 36% of experts indicating that AI will not make much difference.

From the above, it follows that AI has a significant impact on the business processes of transport companies. In this regard, the priority of the development strategy of enterprises in the transport industry should be digitalization.

The results of this study demonstrate the growing impact of digitalization on the transformation of the transport industry. An expert survey showed its advantages and possible risks. To understand the feasibility and complexity of using AI, this study performed a SWOT analysis (Table 1).

Table 1. SWOT – analysis of the use of AI in companies in the transport industry

Strengths	**Weaknesses**
Increasing the efficiency of transportation process management; Improving the quality of services due to more accurate and faster adoption of the optimal decision; Improving the efficiency of the quality of transit	High cost of AI implementation; The need for training and maintenance of AI systems; Limitation of AI in complex and non-standard manifestations;

and multi-intermodal transportation services provided; Increasing the speed and quality of document processing; Minimizing errors associated with human behavior; Reduced operating and administrative costs; Elimination of risks of additional expenses; The transition to electronic document management reduces the harmful impact on the environment; Optimizing fuel consumption has a positive effect on environmental safety.	
Opportunities	**Threats**
Improving the efficiency of planning, distribution and control of resources; Increasing the reliability and functionality of digital services; Improving the reliability of key business processes; Increasing the efficiency of decisions made; Increasing customer loyalty; Increase in productivity; Cost optimization; Reducing paperwork costs.	Possibility of data loss and privacy violations; High competition in the logistics services market; Errors and failures in systems; A constant need for updating.

Source: compiled on the basis of the authors' own research

Thus, the benefits of digital transformation in the transport industry are becoming increasingly widespread. Digitalization opens up new development prospects for transport corridors, helps reduce costs through automation, unification and standardization of business processes, which facilitates effective interaction between partners along the entire transport corridor chain.

To realize these prospects it is necessary:

– active participation of member states of the UN Special Program for the Economies of Central Asia (SPECA) in the implementation of UN legal instruments (conventions and agreements) to facilitate transport and transit;

– use of relevant UN standards, including in the implementation of regional projects of the SPECA and EAEU member states;

– active participation of the Central Asian states, including Kazakhstan, in the global strategies of the EU and China to develop sustainable connections around the world - the Global Gateway and One Belt - One Road initiatives;

– ensure infrastructural compatibility along transport corridors of the SPECA, EAEU and global transit countries;

– unify digital documents based on international agreements;

– create a favorable investment, social, political environment along the digital multimodal transport corridor.

Thus, the current situation of digitalization of the transport industry of the SPECA member states, the EAEU and global transit, including Kazakhstan, indicates the large-scale influence of AI on the development of international multi-intermodal transport corridors.

The contribution of the authors:

Mukhametzhanova A.V. made a significant contribution to the development of the work's concept, including the analysis of the current state of transport industry digitalization. She participated in the development and analysis of the questionnaire to assess the impact of artificial intelligence. Additionally, she contributed to the writing, critical evaluation, and revision of all sections of the text, as well as the approval of the final version of the article for publication.

Zhandarbekova A.M. contributed to the analysis of institutional and technological changes in international transport corridors. She was responsible for the systematization of information on the state and trends of digital transformation. She also participated in writing the text, particularly the sections related to the ecosystem of transport corridors.

Sala D. participated in the critical evaluation of the text and the revision of its substantive content.

Bekzhanova S.E. made a significant contribution to conducting a SWOT analysis of the impact of artificial intelligence implementation at different levels of logistics and participated in writing recommendations for stakeholders in the transport market.

Sultanov T.T. contributed to the development of the work's concept, including the selection of analysis methodologies.

Devetyarova N.V. participated in writing the text, particularly the sections related to the risks of artificial intelligence implementation. She was responsible for studying and addressing issues related to the accuracy and reliability of the data.

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Цифровая трансформация транспортной отрасли: анализ возможностей и рисков

Аннотация. В статье посредством анализа текущего состояния процесса цифровизации транспортной отрасли и оценки результатов анкетирования экспертов выявлена степень воздействия искусственного интеллекта на бизнес-процессы компаний.

Исследование институциональных и технологических изменений в сфере международных транспортных коридоров нашло свое отражение в данной статье. Систематизирована информация о состоянии и основных тенденциях цифровой трансформации коридоров, проанализирована их экосистема, определены заинтересованные стороны и драйверы цифровизации транспортной отрасли. В этой связи надлежащее внедрение стандартов ООН по унификации инфраструктуры, цифровизации бизнес-процессов по упрощению перевозок и транзита требует активного участия субъектов транспортных коридоров.

Разработанная авторами данной статьи анкета по опросу степени воздействия искусственного интеллекта на технологию работы транспортных компании позволила оценить не только преимущества от внедрения искусственного интеллекта, но и возможные риски.

С помощью SWOT анализа изучены последствия внедрения искусственного интеллекта как на микрологистическом, так и на макрологистическом уровне функционирования компаний. Исходя из изученных данных, определены основные направления действий, которым должны следовать субъекты транспортного рынка для повышения уровня цифровизации отрасли.

Ключевые слова: Транспорт, транспортная отрасль, бизнес-процессы, искусственный интеллект, экспертная оценка, цифровизация, трансформация, мультимодальные цифровые транспортные коридоры

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Көлік саласының цифрлық трансформациясы: мүмкіндіктер мен қауіптерді талдау

Аңдатпа. Мақалада көлік саласындағы цифрландыру процесінің қазіргі жағдайын талдау және сарапшылар сауалнамасының нәтижелерін бағалау арқылы жасанды интеллекттің компаниялардың бизнес-процестеріне әсер ету деңгейі анықталды.

Халықаралық көлік дәліздеріндегі институционалдық және технологиялық өзгерістер зерттеліп, мақалада көрініс тапты. Дәліздердің цифрлық трансформациясы жағдайы мен негізгі үрдістері жүйеленді, олардың экожүйесі талданып, мүдделі тараптар мен көлік саласындағы цифрландырудың драйверлері анықталды. Осыған байланысты, инфрақұрылымды біріздендіру, тасымалдау мен транзитті жеңілдету бойынша БҰҰ стандарттарын тиімді енгізу көлік дәліздеріне қатысушылардың белсенді әрекетін талап етеді.

Мақала авторлары жасаған жасанды интеллекттің көлік компанияларының жұмыс технологиясына әсерін бағалауға арналған сауалнама жасанды интеллект енгізудің артықшылықтарын ғана емес, сонымен қатар ықтимал тәуекелдерді де бағалауға мүмкіндік берді.

SWOT талдау әдісі арқылы жасанды интеллектті енгізудің компаниялардың микрологиялық және макрологиялық деңгейлердегі қызметіне тигізетін әсері зерттелді. Зерттелген мәліметтер негізінде көлік нарығына қатысушылардың саланың цифрландыру деңгейін арттыруға бағытталған негізгі әрекет бағыттары анықталды.

Түйін сөздер: Көлік, көлік саласы, бизнес-процестер, жасанды интеллект, сараптамалық бағалау, цифрландыру, трансформация, мультимодальды цифрлық көлік дәліздері.

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