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# THE IMPACT OF THE DIGITAL ECONOMY ON THE DEVELOPMENT OF THE TRANSPORT INDUSTRY

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**Abstract**

In the context of the digital transformation of the global economy, the development of the transport industry is acquiring a new vector, characterized by the active introduction of digital technologies. The digital economy affects all aspects of the transport system, from improving the efficiency of logistics processes to ensuring the safety and sustainability of transport routes. The introduction of technologies such as the Internet of Things (IoT), blockchain, big data and artificial intelligence allows us to automate many processes, minimize risks and increase the transparency of supply chains. These innovations help to speed up the transfer of information, improve monitoring and forecasting, which is important for timely and high-quality customer service.

The digitalization of the transport industry also stimulates its adaptation to changing market needs and increases the competitiveness of companies. For example, the use of data analysis and forecasting systems allows for better management of transport flows, optimize routes and reduce operating costs. Blockchain technologies increase security and trust in information, eliminating the possibility of counterfeiting and fraud, which is especially important in the context of globalization and increasing cross-border transportation. Digital technologies also ensure increased environmental friendliness of transport processes, helping to reduce emissions and switch to alternative energy sources.

Thus, the digital economy is becoming a key driver of innovation in the transport industry, transforming working methods and opening up new prospects for its sustainable and efficient development.

**Keywords:** digital economy, transport industry, logistics, automation, big data, Internet of things, intelligent transport systems, digitalization, cybersecurity, route optimization.

## ВЛИЯНИЕ ЦИФРОВОЙ ЭКОНОМИКИ НА РАЗВИТИЕ ТРАНСПОРТНОЙ ОТРАСЛИ

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**Реферат**

В условиях цифровой трансформации мировой экономики развитие транспортной отрасли приобретает новый вектор, характеризующийся активным внедрением цифровых технологий. Цифровая экономика влияет на все аспекты транспортной системы, от повышения эффективности логистических процессов до обеспечения безопасности и устойчивости транспортных маршрутов. Внедрение таких технологий, как интернет вещей (IoT), блокчейн, большие данные и искусственный интеллект, позволяет автоматизировать многие процессы, минимизировать риски и повысить прозрачность цепочек поставок. Эти инновации способствуют ускорению передачи информации, улучшению мониторинга и прогнозирования, что важно для своевременного и качественного обслуживания клиентов.

Цифровизация транспортной отрасли также стимулирует ее адаптацию к изменяющимся потребностям рынка и повышает конкурентоспособность компаний. Например, использование систем анализа данных и прогнозирования позволяет лучше управлять транспортными потоками, оптимизировать маршруты и снизить эксплуатационные затраты. Блокчейн-технологии повышают безопасность и доверие к информации, исключая возможность подделок и мошенничества, что особенно актуально в условиях глобализации и увеличения трансграничных перевозок. Также цифровые технологии обеспечивают повышение экологичности транспортных процессов, способствуя снижению выбросов и переходу на альтернативные источники энергии.

Таким образом, цифровая экономика становится ключевым драйвером инноваций в транспортной отрасли, трансформируя методы работы и открывая новые перспективы для ее устойчивого и эффективного развития.

**Ключевые слова:** цифровая экономика, транспортная отрасль, логистика, автоматизация, большие данные, интернет вещей, интеллектуальные транспортные системы, цифровизация, кибербезопасность, оптимизация маршрутов.

**Introduction**

The digital economy is fundamentally changing not only the usual areas of interaction, but also fundamental approaches to the management and development of industries. The transport industry, which plays an important role in the global economy, does not remain aloof from these processes. The introduction of digital technologies into the transport system allows not only to increase the efficiency of transportation, but also to improve their environmental sustainability, safety and speed. In the context of growing global trade flows and requirements for sustainable development, the need for digitalization is becoming an integral part of the strategy of successful transport companies and states.

The impact of the digital economy on the transport industry is manifested through such processes as automation of cargo management, integration of intelligent transport systems, application of IoT technologies and use of big data to optimize routes and monitor transport. This allows to significantly increase transparency and control over all stages of logistics chains, as well as minimize the influence of the human factor.

However, digitalization also brings with it a number of challenges, such as cyber threats, the need to modernize existing infrastructure and train personnel in new competencies. Research into these aspects will provide a deeper understanding of how the digital economy influences the development of the transport industry and how it can be adapted to new realities.

The term "digital economy" entered scientific circulation relatively recently, in 1995. It was first actively used by the American economist N. Negroponte, who emphasized the importance of moving the economy to a new level through the use of information and communication technologies [1]. The modern understanding of the term "digitalization" includes a wide range of meanings, but its essential component is not always fully understood. Digitalization is not just the introduction of the

latest technologies to increase competitiveness in the market, but a much deeper process that requires changing the basic approaches to solving socio-economic problems.

Today, there are many areas of development of the digital economy, and their goal is the integration of IT technologies into economic processes. The key factor in digitalization is consumer orientation, market segmentation and improving the quality of services. Significant changes in the market can be achieved through information, which is becoming the main resource, as well as the Internet, which provides unlimited opportunities for the development of economic ties, increased competition and support for small and medium businesses. Some researchers believe that the digital economy is an economy expressed in numbers [2]. We believe that this approach reflects the requirements of the modern era, when prompt access to data and its analysis become the basis for making economic decisions. Thanks to digital technologies, this work is done quickly and conveniently. Moreover, our daily life today is closely connected to the Internet: we often use mobile devices not for calls, but for working with websites and applications.

The Internet is becoming an integral part of people's lives, an increasing number of citizens use online platforms to solve their problems, since it is convenient and often economically beneficial. However, the pace of digitalization in various industries is uneven. For example, in such areas as mechanical engineering or agriculture, digital transformation is much slower than in trade. This is due to the specifics of the functioning of these industries, their scale, the complexity of introducing new technologies, as well as the need for large financial investments and the return on investment in the development of IT solutions.

The transport industry plays an important role in the structure of the economy, being a key element of the national economy. Digitalization of the transport sector is closely linked to the development of the digital economy at the state level [3]. One of the most obvious examples of the introduction of digital technologies in the transport sector is the integration of data between suppliers and users of transport services. This is expressed in the widespread use of electronic tickets and certificates, which are becoming a familiar part of life.

The process of digitalization in transport should include the interaction of all stakeholders: science, education, business and government agencies. Only in the case of close cooperation between these participants can an effective and modern platform for digital management in the transport industry be created [4]. The scientific community is already developing successful strategies and mechanisms for the introduction of digital technologies in this area. Educational institutions should train highly qualified specialists capable of working in a digital economy. The business environment plays a key role in the prompt identification of problems and obstacles arising on the path of digitalization, which allows them to be solved in a timely manner and risks to be minimized.

The digital economy is actively influencing many industries, and the transport industry is no exception. Digitalization provides new opportunities to optimize processes, increase efficiency, and reduce costs. This article examines the main aspects of the influence of the digital economy on the development of the transport industry, as well as the challenges and prospects it faces in the context of global changes [5].

The digital economy includes the use of information and communication technologies (ICT) to improve economic processes. In the transport industry, it helps automate and simplify many aspects, from route planning to monitoring cargo transportation [6]. The use of Big Data, the Internet of Things (IoT), and artificial intelligence (AI) is fundamentally changing the way transport systems operate.

**Automation and optimization of logistics**

One of the key benefits of the digital economy for the transport industry is the automation of processes. Modern control systems allow real-time tracking of the location of vehicles, their load, technical condition, and environmental conditions. This allows for better route planning, reduced downtime, and optimization of supply chains. For example, the use of cloud platforms allows companies to manage warehouse stocks and logistics operations more flexibly and efficiently.

**Big Data and Analytics**

The use of big data in the transport industry significantly improves decision-making processes. Transport companies can collect and analyze huge amounts of data on driver behavior, road conditions, weather conditions, and route congestion. This data is used to forecast demand, identify bottlenecks in the transport system, and improve road safety.

**The Impact of Digitalization on the Efficiency of Transport Systems. Reducing Costs and Improving Profitability**

Automation of processes and the use of digital technologies allow companies to reduce operating costs. For example, fleet management systems help optimize the use of vehicles, reduce fuel consumption, and minimize equipment wear [7]. Thanks to digital platforms, it is possible to significantly reduce the cost of paper documentation and reduce the number of human errors.

**Increasing the speed of delivery and improving the quality of services**

Digital technologies improve customer interaction processes and provide transparency in logistics operations. Customers can track the location of their goods in real time, which increases the level of trust and satisfaction. Fast order processing and accurate delivery time forecasts are possible thanks to digital tools, which leads to improved service quality.

**Challenges of digitalization in the transport industry. Integration of systems**

One of the key challenges of digitalization in the transport industry is the integration of various management systems. Companies often use different platforms to manage logistics, fleets and warehouses, which creates problems of data compatibility and interaction. Developing unified standards and platforms remains an important task for the successful digitalization of the industry.

Digitalization brings not only opportunities, but also risks. With the growth of digital systems, the threat of cyberattacks and unauthorized access to confidential data increases. Ensuring the security of transport systems requires the implementation of modern data protection methods and reliable encryption mechanisms.

**Prospects for the digital transformation of the transport industry**

The future of the transport industry is directly linked to the further development of the digital economy. The development and implementation of unmanned vehicles, the use of blockchain technologies to manage logistics operations and the widespread use of artificial intelligence will open up new horizons for increasing the efficiency and sustainability of transport systems.

The digitalization process, as a key trend of technological progress in the transport industry, has been identified for quite some time. It can be argued that the introduction of digital technologies in this area began almost simultaneously with the emergence of the first electronic computing systems. Over the past years, many different projects have been implemented, both public and private initiatives (Table 1).

In the context of the active development of the digital economy and the formation of a knowledge-oriented information society, which is an important strategic goal, not only in-depth scientific research of risks, systematization of threats and challenges in the field of information security, but also the training of qualified personnel are becoming especially relevant [8]. To ensure reliable information security, a key role is played not only by the technical aspects of protecting the information space and creating a single space of trust, but also by issues of protecting critical information infrastructure.

The use of modern digital communication technologies has opened up opportunities for dynamic remote interaction. More and more people prefer convenient online payments. Mobile payment methods, universal travel documents and the use of applications for transport services have significantly increased the number of users [9].

The creation of digital transport corridors, based on a single information space of electronic documents containing data on cargo, senders and recipients, creates conditions for the implementation of Big Data


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analysis technologies and the transition of the transport sector from a competitive model to a partnership and cooperation model – the main business model in digital logistics. The use of Big Data technologies allows transport companies to manage traffic more effectively by conducting a daily analysis of operations. Structured and thoroughly analyzed data helps to identify new routes and activate unused resources in complex logistics chains. In addition, analytics helps to increase the flexibility of transport systems, providing the ability to promptly adjust delivery routes when unexpected difficulties arise. As Maersk Line CEO R. van Troyen noted, in the Asia-Pacific region, "98 % of all the company's orders are processed digitally, and 50 % of Maersk's orders and documentation are processed through my.maerskline.com, where more than 250,000 transactions are made daily, generating revenue of $ 1.5 million per hour" [10].

**Table 1** – Examples of digitalization in the transport sector

| Application Area | Examples of Digitalization | Impact |
|---|---|---|
| Logistics and Supply Chain Management | Real-time cargo tracking platforms (e. g., GPS, IoT devices) | Increased transparency and control over deliveries |
| | Warehouse automation using robots and AI | Faster order processing, reduced errors |
| Transport Infrastructure | "Smart" roads with sensors for traffic and road condition monitoring | Improved infrastructure planning and accident prevention |
| Urban Transport | Mobile apps for route planning and ticket purchases (e. g., public transport apps) | Convenience for passengers, reduced waiting times |
| | Transport Management Systems (TMS) for optimizing public transport schedules | Increased schedule accuracy, reduced delays |
| Autonomous Vehicles | Deployment of autonomous cars and trucks | Reduced labor costs, enhanced safety |
| Electronic Documentation | Use of electronic waybills (e-CMR) and other digital documents | Reduced paperwork, faster cargo clearance |
| Big Data and Analytics | Use of big data to analyze traffic and weather conditions to optimize routes | Cost reduction, more efficient route planning |
| Cybersecurity | Implementation of cybersecurity systems to protect data and transport networks | Protection from cyberattacks, enhanced system security |
| Fleet Management | Automated fleet tracking and maintenance systems using IoT | Optimized vehicle usage, reduced downtime |

Global leaders in the field of transport and logistics services predict that in the near future, new driverless vehicles will appear on the roads, which will become a key element of digital logistics. One of the key areas in this area will be the use of self-driving trucks. According to the Boston Consulting Group (BCG), the market for ground-based driverless vehicles may exceed US $ 45 billion by 2025, and its rapid growth is expected. McKinsey experts believe that by 2025–2027, every third truck on European roads will be equipped with an autonomous driving system.

Autonomous control systems in such trucks include automatic emergency braking, control of oncoming traffic, and maintaining a constant speed using autopilot. Sensors such as radars and cameras ensure a safe distance from the vehicle in front, reducing the likelihood of accidents. These innovations will reduce the number of road accidents by minimizing the risk of human error and will relieve drivers from the need to spend long periods of time behind the wheel [11].

With the development of technology, digital logistics and transport are taking on new forms, changing the entire system of cargo transportation and logistics chains. These changes are profound and affect the speed, efficiency and safety of logistics processes. The article discusses the key effects that digitalization brings to logistics and transport.

One of the significant advantages of digital logistics is the ability to quickly and accurately process large amounts of information. Technologies such as artificial intelligence and big data allow companies to analyze and forecast demand, allocate resources and optimize routes in real time. Due to this, delivery times are reduced, deadlines are more accurate, and fuel and logistics costs are reduced.

Digital logistics helps to better coordinate the actions of all participants in the transport process, including shippers, carriers, customers and intermediaries. With the help of cloud platforms and specialized applications, it has become possible to manage all document flow, track cargo, place orders and maintain contact with customers online. This eliminates the costs associated with delays and ineffective communication, and allows for a more flexible response to changing conditions and customer requests [12].

Automation and the use of driverless vehicles play an important role in improving road safety. Modern digital systems such as automatic braking, lane keeping, driver monitoring, cameras and sensors help to avoid many accidents. The introduction of driverless truck technologies eliminates the human factor, which often causes errors and accidents. A reduction in the number of accidents leads to improved overall safety and lower insurance costs for companies.

One of the noticeable economic effects of digital logistics is the reduction of transport and logistics costs. Digitalization allows for efficient route planning and the avoidance of empty runs, which reduces fuel consumption and operating costs. Also, the automation of processes such as warehouse logistics and loading and unloading operations helps to reduce labor costs and minimizes the need for manual labor.

Digital transport and logistics contribute to environmental sustainability. Route optimization and the use of data for planning reduce carbon emissions by reducing travel time and fuel consumption. In addition, the development of driverless and electrified vehicles further reduces the carbon footprint, making digital logistics more environmentally friendly and compliant with modern sustainability standards [13].

Digital logistics improves customer service through real-time tracking of parcels and transparency during the delivery process. Customers can monitor their order, receive accurate delivery time forecasts, and make adjustments if necessary. This increases customer trust and satisfaction, promoting loyalty and retention.

With Big Data and AI technologies, companies can forecast needs and analyze logistics flows. Analytics can identify bottlenecks, anticipate potential delays, and plan future deliveries more accurately. This helps companies optimize inventory, avoid warehouse overflows, and deliver products on time, which is an important aspect of logistics management. Digital logistics enables new business models such as resource sharing and Transport-as-a-Service (TaaS) [14]. These models allow companies to adapt more flexibly to market changes, use infrastructure as needed, and reduce capital expenditure. In the context of digital logistics, more and more companies are moving towards a collaborative model, which allows for more efficient use of capacity and lower costs. A digital transport system allows for a quick response to unforeseen circumstances, such as traffic delays or changing weather conditions. By integrating data from various sources, companies can change routes in real time and minimize risks. This is especially important in a globalized world, where transport chains are becoming longer and more complex, and unforeseen circumstances can seriously disrupt the delivery plan.

Automation and robotization of traffic flow control, traffic situation forecasting and support for autopilot systems reduce dependence on the human factor, minimize errors and improve train traffic management, as well as their maintenance.

Automation of transport management systems and active involvement of the client in cargo control processes contribute to more efficient logistics management [15]. Digital platforms aimed at providing logistics services, including ticket booking, carrier search and selection of optimal routes, have made a significant contribution to the digitalization of the transport industry.

One of the key areas remains the implementation of "smart" transport, which allows monitoring, management and optimization of transport systems using advanced technologies.

Digitalization of the transport sector has opened up new prospects for the efficient management of logistics processes, simplifying and accelerating information exchange, tracking of cargo shipments, and remote management of operations. The introduction of these technologies has also helped to significantly improve the efficiency of management processes.

The digital economy has a significant impact on the development of the transport industry, leading to the automation of processes, improved logistics and higher quality of services. However, successful digitalization requires overcoming challenges such as system integration and cybersecurity. Given technological changes and innovations, the prospects for digital transformation in the transport industry seem very promising [16].

The digital economy is a radically new approach to economic interactions at the global level, consisting in the deep integration of IT technologies with economic processes. Among the key areas of implementation of digital solutions in the automotive industry are the following:

– Firstly, creating conditions for increasing the comfort and efficiency of transport services for consumers.

– Secondly, organizing a system of regular monitoring and quality control of the road surface in accordance with the standards of safe operation.

– Thirdly, solving road safety issues through remote monitoring of compliance with traffic rules by all road users with immediate punishment of violators.

Investments in infrastructure development, technological competition and increasing the level of education of the population are the main factors contributing to the acceleration of the digital transformation of the country's economy.

**References**


1. Negroponte, N. Being digital / N. Negroponte. – Hodder & Stoughtong,1995. – 243 p.
2. Patrusova, A. M. Modern information technologies for assessing the effectiveness of investment IT projects / A. M. Patrusova // Modern technologies. Systems analysis. Modeling. – 2014. – No. 2 (42). – P. 92–96.
3. Bolshedvorova, L. V. Information culture as a factor in the development of the information society / L. V. Bolshedvorova, V. V. Kosyakova // Current issues of the regional economy: analysis, diagnostics and forecasting: materials of the VI International student scientific-practical conferences (April 6, 2016). – N. Novgorod, 2016. – P. 270–273.
4. Lomov, I. I. Automation of the process of sale and accounting of insurance products in commercial banks / I. I. Lomov, M. Yu. Vakhrusheva // Problems of socio-economic development of Siberia. – 2018. – No. 2 (32). – P. 64–70.
5. Study of self-actualization needs of Russian students as a factor of competitiveness in the labor market / E. G. Grudistova, D. A. Pastuhova, A. M. Slinkov [et al.] // Espacios. – 2019. – Vol. 40, No. 26. – P. 18.
6. Patrusova, A. M. Process management: Some implementation aspects / A. M. Patrusova, M. Y. Vahrusheva // IOP Conference Series: Materials Science and Engineering. – 2020. – Vol. 753 (8). – DOI: 10.1088/1757-899X/753/8/082028.
7. Order of the Government of the Russian Federation No. 1734-r dated on November 22, 2008 (as amended, dated on May 12, 2018) "On the Transport Strategy of the Russian Federation", Legal reference system "ConsultantPlus". – URL: https://www.consultant.ru/document/cons_doc_LAW_82617 (date of access: 01.08.2024).
8. Akopova, E. S. Mirovaya transportno-logisticheskaya infrastruktura: cifrovaya transformaciya 2020 goda / E. S. Akopova, E. K. Pilivanova, S. I. Samygin // Gosudarstvennoe i municipal'noe upravlenie. Uchenye zapiski. – 2021. – № 1. – S. 87–92. – DOI: 10.22394/2079-1690-2021-1-1-87-92.
9. Arhipov, A. E. Transformaciya transportnoj otrasli Rossii pod vliyaniem cifrovyh tekhnologij / A. E. Arhipov, A. E. Ryapisov // Ekonomika i biznes: teoriya i praktika. – 2020. – Vol. 4–1 (62). – S. 22–24. – DOI: 10.24411/2411-0450-2020-10249.
10. Volovik, N. A. Delovaya reputaciya kak faktor povysheniya effektivnosti deyatel'nosti kompanii / N. A. Volovik // Mezhdunarodnyj zhurnal gumanitarnyh i estestvennyh nauk. – 2017. – №5. – S. 96–98.
11. King, M. Carriers 'best placed to control digital shipping', claims Maersk. – URL: https://www.lloydsloadinglist.com/freight-directory/news/Carriers-'best-placed-to-control-digital-shipping'-claims-Maersk/68197 (date of access: 27.09.2024).
12. Gorishnyaya, A. A. Modelirovanie stoimosti delovoj reputacii transportnyh kompanij v usloviyah cifrovizacii ekonomiki / A. A. Gorishnyaya // Intellektual'nye resursy – regional'nomu razvitiyu: sbornik nauchnyh trudov. – 2020. – № 2. – S. 356–360. – URL: https://cyberleninka.ru/article/n/tsifrovye-tehnologii-v-transportnoy-logistike (date of access: 30.09.2024).
13. Komarova, E. A. Klyuchevye elementy innovacionnogo razvitiya v sfere logisticheskoj deyatel'nosti / E. A. Komarova // Intellektual'nye resursy – regional'nomu razvitiyu: sbornik nauchnyh trudov. – 2017. – № 1–2. – S. 649–653.
14. YAguzinskaya, I. YU. Perspektivy vnedreniya i razvitiya informacionnyh sistem v transportnoj logistike / I. YU. YAguzinskaya, E. O. Biryukov // Nauchno-metodicheskij elektronnyj zhurnal Koncept. – 2015. – T. 35. – S. 151–155.
15. Schwab, K. The Fourth Industrial Revolution. World Economic Forum. – 2016. – URL: https://www.weforum.org/about/the-fourth-industrial-revolution-by-klaus-schwab (date of access: 05.10.2024).
16. Bukht, R. Defining, Conceptualising and Measuring the Digital Economy / R. Bukht, R. Heeks // Development Informatics Working Paper. – 2017. – Vol. 68. – DOI: 10.2139/ssrn.3431732
17. Castells, M. The Rise of the Network Society. Wiley-Blackwell / M. Castells. – 2010. – 656 p. – URL: https://www.wiley.com/en-us/The+Rise+of+the+Network+Society-p-9781405196864 (date of access: 08.10.2024).
18. The Impact of Digitalisation on the Transport Sector: Key Findings. OECD // International Transport Forum. – 2019. – URL: https://www.itf-oecd.org/impact-digitalisation-transport-sector (date of access: 08.10.2024).
19. Deighton, J. The Economic Value of the Digital Economy / J. Deighton, L. Kornfeld // Journal of Economic Perspectives. – 2018. – Vol. 32(2). – P. 3–30. – DOI: 10.1257/jep.32.2.3.
20. Digital America: A Tale of the Haves and Have-Mores / J. Manyika, S. Ramaswamy, S. Khanna [et al.] // McKinsey Global Institute. – 2019. – URL: https://www.mckinsey.com/mgi/overview/digital-america (date of access: 08.10.2024).
21. Deloitte. Digital Transformation in Transport and Logistics: Increasing Efficiency and Effectiveness. Deloitte Insights. – 2020. – URL: https://www2.deloitte.com/content/dam/Deloitte/global/Documents (date of access: 08.10.2024).
22. Glushkova, A. Digital Economy Impact on the Development of the Transport Sector in Russia / A. Glushkova, V. Smirnov // Russian Economic Development. – 2022. – Vol. 28(2). – P. 72–84.
23. Digitalization of Transport Logistics in the Context of the Fourth Industrial Revolution / S. Barykin [et al.] // Journal of Logistics and Supply Chain Management. – 2021. – Vol. 14(1). – P. 15–28.
24. Jiang, X. The Role of Big Data and AI in Optimizing Transport Efficiency in the Digital Economy / X. Jiang, Y. Liu // Transportation Science. – 2022. – Vol. 56(3) – P. 203–215.
25. Glushkova, A. Digital Economy Impact on the Development of the Transport Sector in Russia / A. Glushkova, V. Smirnov // Russian Economic Development. – 2022. – Vol. 28(2). – P. 72–84.
26. Harnessing the Digital Economy for Growth and Sustainable Development in Transport // The World Bank. – 2021.


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