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# AUTOMATION AND DIGITALIZATION OF LOGISTIC CLUSTERS IN INTERNATIONAL TRANSPORTATION OF FOOD INDUSTRY PRODUCTS

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**Summary.** The conducted study identified the main structural and functional characteristics of logistics clusters in the food industry. A classification of the stages of digital transformation of logistics clusters has been developed, starting from the analysis of current processes to identify weaknesses and needs, up to full automation and integration of analytical platforms. Innovative automation scenarios for international food product transportation have been highlighted. Strategies for the development of logistics clusters have been proposed based on global trends and regulatory requirements through the integration of automated solutions, big data analytics, AI-driven logistics chain optimization, blockchain for supply chain transparency, autonomous transport and drones, as well as partnership cooperation models.

**Keywords:** digital transformation, logistics clusters, automation, intelligent digital systems, food industry.

**Relevance of the problem.** The relevance of the problem is that, under current conditions of globalization and increasing demands for the efficiency of international food product transportation, logistics clusters play a key role in ensuring the continuity, speed, and safety of supply chains. At the same time, traditional logistics models, based on manual process management, demonstrate insufficient flexibility in responding to the challenges of the modern economy, including demand fluctuations, geopolitical risks, regulatory changes, the need to reduce the environmental footprint, and the digital transformation of global markets. Automation and digitalization of logistics clusters are strategically important for optimizing freight flows, improving supply chain transparency, minimizing operational costs, and forming adaptive and sustainable supply chains. The application of innovative digital transformation technologies allows for the creation of intelligent logistics hubs that integrate manufacturers, transport companies, warehouses, and retail networks into a single digital ecosystem, which significantly enhances the efficiency of international transportation processes. However, the implementation of such changes faces barriers related to the need for standardization, regulation adaptation, and high investment costs, which require in-depth study of this issue.

**Analysis of recent research and publications.** The issues related to the study of the essence, features of integration, and implementation of modern digital transformation technologies in international logistics processes have been explored by

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the following foreign experts: Grzybowska K., Cyplik P. [1], Liu S., He N., Cao X., Li G., Jian M. [2], Cekerevac Z., Kirova A. [3], Hryhorak M., Trushkina N., Popkowski T., Molchanova K. [4], Nitsche B., Straube F. [5], Nagy G., Bányainé Tóth Á., Illés B., Varga A.K. [6], Krstić M., Jovanović V., Radivojević G., Đorđević D., Stojić G. [7], Barreto L., Amaral A., Pereira T. [8]. However, the issue of developing strategies for the growth of logistics clusters in the food industry, considering modern global trends, technological capabilities, and regulatory requirements, as well as the development of innovative scenarios for the automation and digitalization of logistics clusters in the field of international food transportation, has not been previously considered.

**The purpose of the article** is to investigate the structural and functional characteristics of logistics clusters in the food industry, their role in the sustainable development of international supply chains, their adaptation to digital transformation and economic challenges, as well as to determine the impact of automation tools, digital technologies, and artificial intelligence on the efficiency, transparency, and speed of logistics operations.

**Research results.** Globalization and the increasing complexity of international supply chains set new challenges for the food industry, requiring efficient logistics solutions. Logistics clusters play a key role in ensuring the stability, speed, and safety of international food transportation. However, traditional management methods no longer in line with the dynamics of the modern market. Therefore, the automation and digitalization of logistics processes have become a primary focus for improvement, providing flexibility, transparency, and sustainability in transportation systems. Thus, it is advisable to analyze modern digital technologies for the automation and digitalization of logistics clusters in international food transportation, see Fig. 1.

According to Fig. 1, the digitalization and automation of logistics clusters in international food transportation is a multidimensional process in which the integration of innovative technologies creates a synergistic effect, optimizing all key stages of the logistics chain. The use of IoT enables continuous cargo condition monitoring, which is critically important for maintaining proper temperature and humidity levels while providing a high degree of transparency in transportation [7; 14]. The interaction of IoT with artificial intelligence increases the efficiency of route optimization, reducing delays and improving delivery time accuracy, which ultimately reduces costs. Furthermore, block-

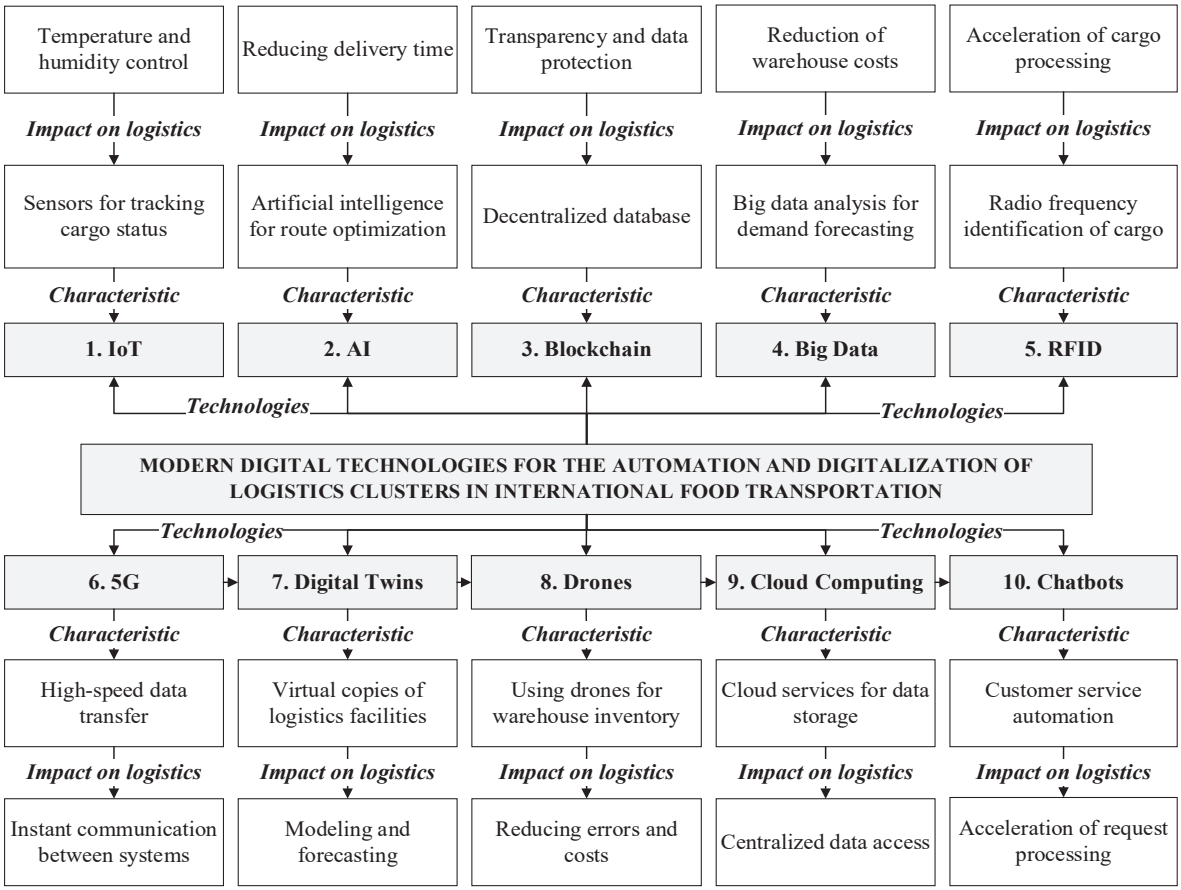


**Figure 1 – Modern digital technologies for the automation and digitalization of logistics clusters in international food transportation**

*Source: formed by the authors based on sources [7–14]*

chain technology creates a reliable mechanism for data protection and management, preventing fraud and increasing trust among logistics stakeholders. The use of Big Data significantly expands the capabilities of analytical demand forecasting, allowing enterprises to quickly adapt production and logistics to market changes, minimizing excess inventory and reducing warehousing costs [8; 12]. RFID technology speeds up cargo processing through radio-frequency identification, which is particularly relevant in high-turnover environments where fast processing of large quantities of products is important [7; 8; 11].

Further enhancing technological integration is achieved through the implementation of 5G, which enables instantaneous communication between systems, reducing delays in the transmission of critical data. The adoption of Digital Twins enables the creation of virtual copies of logistics facilities, which allows not only to analyze the current state of the system, but also to model its development scenarios, providing a more accurate assessment of potential risks and the economic efficiency of management decisions [8; 13]. The use of drones significantly reduces warehouse logistics costs and minimizes the likelihood of errors, increasing the overall cargo handling efficiency. Cloud computing centralizes data access, increasing the speed of decision making and ensuring the scalability of logistics processes [7; 8]. The implementation of chatbots automates customer service, significantly speeding up the processing of requests and improving the quality of communication between logistics operators and clients.

Thus, the combined effect of modern digital technologies creates an efficient, flexible, and highly productive logistics system capable of quickly adapting to global market challenges, minimizing risks, and providing an optimal balance between speed, cost and service quality.

We have identified the main participants of the logistics cluster and their role in the context of digitalization, see Fig. 2.


**Figure 2 – The main participants of the logistics cluster and their role in the context of digitalization**

*Source: formed by the authors based on sources [7–9; 11–14]*

According to the data in Fig. 2, the digitalization of logistics clusters radically transforms the interaction of key participants in transport and logistics processes, creating an integrated supply chain management system, where technological interaction determines the efficiency of each stage. Suppliers play a critical role in communicating product availability data, using IoT and Big Data to provide transparency and timely updates of information, forming the basis for accurate demand forecasting [7; 8; 12; 14]. Transport companies, leveraging GPS, AI, and Blockchain, optimize routes and minimize downtime, reducing costs and increasing delivery speed. Logistics hubs serve as central hubs for coordinating transportation, using 5G and cloud computing to share real-time data and scale logistics processes. Warehouse operators integrate RFID, drones, and Digital Twins to optimize inventory management and reduce the risk of warehouse overload, increasing processing speeds and reducing operating costs [11; 13]. Retailers, in turn, apply AI and chatbots to forecast demand and automate interactions with end consumers, providing a personalized approach and speeding up product supply decisions [8; 10].

Customs authorities play a critical role in the digital transformation of logistics clusters, using Blockchain and RFID to automate cargo processing and speed up border crossing procedures, significantly reducing delays and preventing violations. Insurance companies utilize Big Data and AI to predict potential risks and decrease the likelihood of insurance claims, enhancing the financial stability of participants in logistics processes. Financial institutions use Smart Contracts to automate payments and credit transactions, eliminating transaction delays and reducing fraud risks. Government regulators monitor compliance with standards by using Blockchain and Big Data to track regulatory data, ensuring transparency and compliance with international logistics regulations. IT companies play a central role in supporting digitalization by developing AI- and cloud-based solutions, ensuring comprehensive integration of all cluster participants and increasing the overall system efficiency. Thus, the digital transformation of logistics clusters not only increases productivity and reduces costs, but also creates a flexible, adaptive system capable of responding to global market challenges, ensuring high precision, speed and safety of all logistics processes.

The main challenges of logistics clusters digitalization in the field of international transportation of food products are presented in Fig. 3.

The digitalization of logistics clusters in international food transportation faces a number of economic, technological, regulatory and organizational challenges that significantly affect the efficiency and speed of implementation of innovative solutions. The high cost of adopting digital technologies is a major barrier, as expensive technologies require significant investment, delaying their widespread adoption. However, potential solutions such as government subsidies could partially alleviate this problem. A lack of qualified specialists leads to operational errors of new digital systems, making it difficult to use them effectively [3]. This problem can be solved by introducing personnel training and certification programs. Another obstacle is the interaction between different information systems, as low compatibility of solutions from different providers makes data exchange difficult. This problem can be solved by developing common standards. Regulatory restrictions also slow down digitalization, as different requirements across jurisdictions create a complex regulatory framework that requires flexible compliance systems to optimize technology integration. In addition, infrastructure constraints such as outdated transport networks lead to delays in supply chains. This challenge can be overcome by attracting investments in modernization [4; 5]. In addition to technical challenges, there are also socio-economic factors, including stakeholder skepticism that makes it difficult to invest in new technologies, which slows down decision-making [6].

This issue can be addressed by raising awareness and demonstrating the effectiveness of digital tools. Limited internet access in some regions creates a risk of real-time data loss, which can be minimized by expanding 5G networks. The large volume of data makes real-time analytics difficult due to insufficient computing power. This problem can be solved by implementing cloud technologies. Resistance to change caused by traditional ways of working and staff reluctance to automate processes hinders digital transformation. This problem can be solved by implementing employee adaptation programs that will ease the transition to new technological environments. Taken together, these challenges require a comprehensive approach that includes financial incentives, educational initiatives, technological standardization and corporate culture transformation. Such measures will ensure effective digitalization of logistics clusters and increase their competitiveness in the global market.

A comparison of traditional and digital logistics clusters is presented in Tab. 1.

As can be seen from the data in Tab. 1, traditional clusters are characterized by moderate order processing speed, low supply chain transparency, high transportation costs and limited logistics flexibility, while digital solutions provide high speed, cost optimization and adaptability to changing market conditions. The high level of automation and forecast accuracy in digital clusters helps minimize errors and delays, which is critical for dynamic warehouse resource management [2]. While traditional logistics relies on the long-term use of warehouse space, dig-


**Figure 3 – The main challenges of logistics clusters digitalization in the international transportation of food products**

*Source: formed by the authors based on sources [3–6]*

**Table 1 – Comparison of traditional and digital logistics clusters**

| № | Parameter | Traditional cluster | Digital cluster | The impact of digitalization |
|---|---|---|---|---|
| 1 | Order processing speed | Medium | High | Downtime reduction |
| 2 | Supply chain transparency | Low | High | Control at all stages |
| 3 | Transportation costs | High | Optimized | Cost reduction |
| 4 | Logistics flexibility | Limited | Adaptive | Demand response |
| 5 | Level of automation | Low | High | Error reduction |
| 6 | Prediction accuracy | Medium | High | Delay minimization |
| 7 | Warehouse use | Long-term | Dynamic | Downtime reduction |
| 8 | Level of security | Standard | Elevated | Cybersecurity |
| 9 | Speed of interaction between participants | Low | High | Reduction in approval time |
| 10 | Goods damage control | Limited | Automated | Reduction in losses |

*Source: formed by the authors based on sources [1–4]*

ital technologies make it dynamic, directly impacting the reduction of downtime and the increase in the efficiency of logistics operations. An important aspect is to increase the security of digital clusters due to cybersecurity measures, in contrast to the standard approaches of traditional logistics [3; 4]. The high speed of interaction between participants and automated control of cargo damage in digital clusters help reduce coordination time and minimize losses, significantly increasing the overall productivity of logistics systems.

The main stages of logistics clusters digital transformation in the field of international transportation of food products are presented in Tab. 2.

**Table 2 – The main stages of logistics clusters digital transformation in the international transportation of food products**

| № | Stage | Digital technologies | Key participants | Results |
|---|---|---|---|---|
| 1 | Analysis of current processes | IoT, Big Data | Logistics companies, customers | Identifying weaknesses and the need for digitalization |
| 2 | Choosing digital solutions | AI, Cloud, Blockchain | IT department, suppliers | Digitalization strategies, choosing optimal solutions |
| 3 | Integration of new technologies | Cloud Computing, ERP | Logistics companies | Integrating new solutions into existing systems |
| 4 | Process automation | Robotization, AI, IoT | Logistics operators | Automating routine logistics tasks |
| 5 | Process optimization | Big Data, Machine Learning | Operators, customers | Improving efficiency and processing speed |
| 6 | Monitoring and management | AI, IoT, Blockchain | Managers, regulators | Improving process control |
| 7 | Security improvement | Blockchain, Cloud Security | IT security, regulators | Data protection and information security |
| 8 | Learning and adaptation | Online courses, AR/VR | HR department, personnel | Employee training |
| 9 | Results assessment | AI, Big Data, Blockchain | Logistics companies, analysts | Determining the success of digitalization and its effectiveness |
| 10 | Technology scaling | Cloud Computing, IoT, AI | Logistics companies, partners | Expanding into new markets and countries |

*Source: formed by the authors*

According to the data in Tab. 2, the digital transformation of logistics clusters is a multi-level process that includes successive stages of modern technologies implementation, new solutions integration and their further optimization. The first stage involves analyzing current processes using IoT and Big Data, which allows identifying weaknesses and determining digitalization needs. The subsequent selection of technological solutions is based on the use of artificial intelligence (AI), cloud computing and blockchain, which facilitates the development of digital integration strategies. The integration of new technologies, such as ERP and cloud computing, expands the capabilities of existing logistics systems, increasing their adaptability to market changes. A key aspect is process automation using robotics, IoT and AI, which minimizes the influence of the human factor and increases the efficiency of routine logistics tasks. Process optimization plays a major role, using Big Data and machine learning to enable operators and clients to achieve faster and more accurate order processing results. Monitoring and management systems based on IoT, AI and blockchain provide more precise control over logistics operations, improving service quality. Data protection and increased security are ensured through the implementation of blockchain technologies and cybersecurity solutions, which minimize the risks of data loss or manipulation. An equally important aspect is personnel training and adaptation, carried out through online courses, augmented reality (AR) and virtual reality (VR), which provide a deeper understanding and more effective use of new technologies. The results of digital transformation are assessed using Big Data and AI, which allows not only to determine the effectiveness of the implemented solutions, but also to adjust future development strategies. The final stage involves scaling technologies to new markets and countries through the integration of cloud computing, IoT and expanded collaboration between logistics companies and their partners.

Fig. 4 presents the proposed strategies for the development of logistics clusters in the food industry, taking into account modern global trends, technical capabilities and regulatory requirements.

The strategies for the development of logistics clusters in the food industry presented in Fig. 4 are determined by the comprehensive implementation of innovative technologies based on automation, analytical processing of large datasets, algorithmic optimization of logistics processes and increased information transparency. A key aspect of the effective functioning of such clusters is the implementation of modern robotic solutions to optimize warehouse operations and transportation accounting, which, in turn, helps to minimize transaction costs and significantly reduce order processing time.

Combined with predictive models built on big data analytics, this approach allows not only to adapt supply chains to dynamic market changes, but also to develop proactive inventory management strategies that are critical to reducing storage costs and ensuring continuity of supply.

The synergy of automated systems and algorithmic decision-making mechanisms in the context of dynamically changing factors of the transport environment contributes to the development


**Figure 4 – Strategies for the development of logistics clusters in the food industry, taking into account modern global trends, technical capabilities and regulatory requirements**

*Source: formed by the authors*

of flexible logistics routes that can be adjusted in real time. Using artificial intelligence to optimize delivery routes can simultaneously minimize operating costs, reduce environmental impact by eliminating redundant logistics operations, and increase order fulfillment speed, which is critical in the food industry, where sensitivity to delivery times directly impacts product quality. Equally important is the use of blockchain technologies to increase the transparency of supply chains, eliminate information asymmetry between counterparties, reduce the risk of fraudulent schemes and increase the level of trust between market participants. In this context, the digital transformation of logistics clusters not only provides greater control over the movement of goods but also helps to harmonize the interaction of manufacturers, suppliers, distributors and end consumers through the creation of a unified digital ecosystem for supply chain management. Further modernization of logistics processes involves the active implementation of autonomous vehicles, including drones and robotic sorting mechanisms, which help reduce human involvement in critical operations, optimize the speed of cargo handling and minimize costs associated with manual processing errors. This creates the basis for building adaptive and self-regulating logistics systems capable of a high level of automated self-adjustment in response to current operating conditions.

According to the data presented in Fig. 1–4 and Tab. 1–2, it is advisable to develop innovative scenarios for the automation and digitalization of logistics clusters in the field of international transportation of food products (see Tab. 3).

**Table 3 – Innovative scenarios for the automation and digitalization of logistics clusters in international transportation of food products**

| № | Scenario name | Scenario detailing |
|---|---|---|
| 1 | Automated optimization of freight routes | The AI algorithm analyzes road traffic, weather conditions and traffic jams in real time. The GPS tracker tracks truck traffic, and AI suggests optimal routes. The dispatcher confirms the route, and the driver receives an updated route via the navigation system. If road conditions change, the route is automatically adjusted. The customer receives the current ETA, and the monitoring system monitors the delivery. |
| 2 | Smart warehousing with robotic forklifts | When a new product arrives, RFID scanners read the information, and the AI algorithm determines the optimal storage location. Robots automatically place the product in the warehouse, and the ERP system updates availability data. When picking orders, AI optimizes the sequence of actions, and forklifts quickly and without errors form orders. |
| 3 | Digital customs clearance of cargo | Cargo documents are uploaded to the Blockchain, where AI checks their correctness. Customs accesses encrypted data and analyzes risks using AI. If there are no violations, the cargo crosses the border automatically without delays. AI records transit time and updates cargo status in the logistics system. |
| 4 | Temperature control in refrigerated containers with IoT | IoT sensors record temperature and humidity in containers and transmit data to the cloud. AI algorithms analyze indicators in real time. In case of deviations, the system sends an alarm signal to the driver and logistics operator. All data is recorded in the Blockchain for transparency. The buyer receives confirmation of storage conditions via QR code. |
| 5 | Automation of payments in logistics clusters through Smart Contracts | Smart Contracts automatically manage financial transactions in logistics. After the buyer confirms the order, the bank reserves funds, and the system tracks the movement of the goods. After passing customs and checking with IoT sensors, the Smart Contract automatically makes a payment to the seller, which eliminates delays and increases the transparency of payments. |
| 6 | Digital twin of the logistics cluster | Logistics data on warehouses, routes and costs are uploaded to the Digital Twin platform. AI creates a digital twin of the logistics system and models various scenarios. A financial analyst assesses economic efficiency, and government regulators monitor compliance with regulations. |
| 7 | Predictive demand analytics and procurement automation | AI analyzes historical sales data, seasonal trends and external factors to forecast demand. Manufacturers receive automatic orders, and logistics optimizes delivery routes. The finance department calculates the budget, and AI adjusts the forecast in real time. |
| 8 | Returns management and goods processing | AI analyzes the reasons for returns and automatically redistributes returned goods: for resale, processing or disposal. Logistics optimizes return routes, reducing costs. An AI reporting system predicts return trends and suggests strategies to reduce them. |
| 9 | Intelligent quality control in production and logistics | AI cameras monitor product quality on the conveyor, detecting defects. Defective products are sent for processing, and quality products are packaged. IoT sensors monitor transportation conditions, and retail chains receive quality data even before receiving the goods. Consumers can check the product history via QR code. AI predicts possible defects and helps reduce the number of defects. |

*Source: formed by the authors*

As can be seen from the data in Tab. 3, automation and digitalization of logistics clusters in the field of international food transportation are forming a fundamentally new paradigm for managing global supply chains, in which artificial intelligence (AI), IoT, Blockchain and digital twins play a key role.

The integration of these technologies not only speeds up operational processes, but also significantly reduces the uncertainty that has traditionally been a critical factor in the transportation of perishable goods. AI-driven route optimization enables logistics strategies to dynamically adapt to changing external conditions such as traffic congestion, weather risks and infrastructure availability, directly impacting delivery time reduction and improving ETA accuracy. The integration of robotic warehousing systems and automated inventory management minimizes errors in cargo placement and assembly, thereby reducing costs associated with the human factors and increasing the efficiency of goods turnover. The implementation of digital customs clearance based on Blockchain and AI technologies reduces bureaucratic delays, prevents document manipulation and reduces the risk of fraud through data transparency, significantly increasing trust among supply chain participants. IoT sensors monitoring the parameters of refrigerated containers, combined with AI-based data analysis, ensure product quality is maintained throughout the entire logistics cycle. Additionally, the integration of smart contracts into payment processes enables full automation of financial transactions, eliminating problems associated with payment delays or counterparty financial risks. Using Digital Twin technology as a simulation modeling tool to evaluate alternative

logistics cluster management scenarios allows businesses to predict the consequences of management decisions without actually implementing them, minimizing potential losses and providing the ability to dynamically adjust business strategy.

Meanwhile, predictive demand analytics integrated into automated purchasing systems reduces the risk of excess inventory and losses due to product spoilage, which is a critical aspect for the food and retail industries. At the same time, digital returns management not only reduces logistics and disposal costs, but also creates preconditions for the recycling of products, which is in line with the principles of a circular economy. Finally, the application of AI-based product quality analysis at both the production and logistics stages improves defect detection, reduces waste and has a positive impact on both the manufacturer's reputation and end-customer satisfaction. The combination of these technological innovations not only transforms the way we manage international food transportation, but also lays the foundation for further automation of the entire supply chain, ensuring its sustainability, efficiency and compliance with global safety and quality standards.

**Conclusions.** The conducted study has allowed to form a comprehensive understanding of the strategic imperatives of digital transformation in logistics clusters in the field of international food transportation, to identify key mechanisms for its implementation and structural determinants of efficiency. It has been revealed that the digitalization process is not only an instrumental factor in optimizing operational activities, but also a systemic transformation that defines new models of supply chain management and changes the fundamental principles of interaction among participants in the logistics network. It has been substantiated that the implementation of algorithms for predictive demand analytics reduces the likelihood of destructive fluctuations in supply planning, minimizes the risks of excessive accumulation of stocks and financial losses caused by depreciation. The use of artificial intelligence in product quality control transforms defect detection mechanisms, increasing the objectivity and speed of decision-making, which directly correlates with the level of trust in suppliers in global trade chains. The critical importance of digitalization as a tool for increasing the sustainability of logistics systems, ensuring their compliance with international safety standards, and increasing the competitiveness of enterprises in the field of international transportation of food products has been confirmed. The obtained results can be used to develop strategic digital transformation initiatives and their assessment, improve regulatory approaches to ensuring continuity of supply, and form a regulatory framework for integrating intelligent management systems into global logistics processes.

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# АВТОМАТИЗАЦІЯ ТА ЦИФРОВІЗАЦІЯ ЛОГІСТИЧНИХ КЛАСТЕРІВ У МІЖНАРОДНИХ ПЕРЕВЕЗЕННЯХ ПРОДУКТІВ ХАРЧОВОЇ ПРОМИСЛОВОСТІ

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**Анотація.** У ході проведеного дослідження визначено основні структурно-функціональні характеристики логістичних кластерів у харчовій промисловості, їх роль у сталому розвитку міжнародних ланцюгів поставок. Проведено комплексний аналіз впливу автоматизації, цифрових технологій і штучного інтелекту на ефективність, прозорість і швидкість логістичних операцій. Особливу увагу в дослідженні приділено можливості інтеграції автоматизованих систем управління, блокчейн-платформ, IoT, AI, RFID, Digital Twins, хмарних сервісів і великих даних. Визначено ключових учасників логістичних кластерів, серед яких підприємства харчової промисловості, логістичні оператори, державні установи та технологічні платформи. Визначено стратегічні переваги цифрових кластерів порівняно з традиційними логістичними системами, зокрема завдяки інтеграції ШІ, прогнозної аналітики та безпаперового документообігу. Розроблено класифікацію етапів цифрової трансформації логістичних кластерів, починаючи від аналізу поточних процесів для виявлення недоліків і потреб, до повної автоматизації та інтеграції аналітичних платформ. В роботі окреслено ключові виклики цифровізації, включаючи регуляторні обмеження, високі капітальні витрати та необхідність реструктуризації існуючих бізнес-моделей. В дослідженні виділено інноваційні сценарії автоматизації для міжнародних транспортувань продуктів харчування, включаючи оптимізацію логістичних маршрутів, роботизоване складування, цифрове митне оформлення, контроль температури на основі Інтернету речей, смарт-контракти для автоматизації платежів, цифрові двійники логістичних кластерів і прогнозну аналітику попиту. Стратегії розвитку логістичних кластерів були запропоновані на основі глобальних тенденцій і нормативних вимог шляхом інтеграції автоматизованих рішень, аналітики великих даних, оптимізації логістичного ланцюга на основі штучного інтелекту, блокчейну для прозорості ланцюга постачання, автономного транспорту та дронів, а також моделей партнерської співпраці. Отримані результати сприяють глибшому науковому розумінню розвитку міжнародних логістичних кластерів і закладають основу для подальших досліджень оцінки впливу цифрових екосистем і автономних технологій на глобальні ланцюги поставок.

**Ключові слова:** цифрова трансформація, логістичні кластери, автоматизація, інтелектуальні цифрові системи, харчова промисловість.

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