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INTRODUCTION

We are happy to invite you to get acquainted with the first issue of the new scientific and practical publication "Intellectualization of Logistics and Supply Chain Management".

We strongly believe that the launch of this magazine indicates the objective need to rethink a wide range of issues related to the development of theory and practice in logistics and supply chain management, awareness of the need to unite the scientific community and logistics practitioners, dissemination of modern knowledge and best practices for innovative development of the logistics services market.

The first issue of the magazine is published at a difficult time. The global coronavirus pandemic and the deep economic crisis have significantly worsened business activity in the world. Currently, global supply chains are collapsing, international trade is declining, and competition between global and regional logistics operators is intensifying. The most common thesis is that the world will never be the same again. Industry experts predict the emergence of new, more flexible and adaptive supply chain management strategies and approaches to logistics business process management. The trend towards collaborations, cooperation and unification of services is emerging, comprehensive proposals for clients are being developed. There is increasing talk about the need to build bimodal supply chains, which involves the development of different decision-making scenarios: the traditional approach - cost-effective efficiency, low risk, high predictability; a new approach "second mode" - rapid recognition of opportunities, adaptability, willingness to solve unexpected problems and look for new opportunities.

Radical transformations of the global and national markets for logistics services require appropriate scientific support. Logistics science has a special role to play in this process. Initiating the emergence of a new journal, we decided to focus on its coverage of problematic aspects of the formation and development of logistics systems at the micro, mezo and macro levels, supply chain management, digitization of logistics, methods and tools for optimizing processes in logistics and supply chains, sociopsychology relations and network interaction of enterprises using cloud technologies, artificial intelligence, e-learning, neural business process management systems, etc.

Therefore, we invite scientists, researchers and business representatives, as well as our colleagues from abroad, to cooperate and present the results of scientific research, to discus and debate on them, to work together to develop the scientific theory of logistics and promote mutual intellectual enrichment.

We hope that the new scientific publication will become a theoretical guide for young researchers and representatives of other fields.

HRYHORAK Mariia
Chief Editor

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PLANNING THE CUSTOMER SERVICE PROCESS OF A LOGISTICS COMPANY BASED ON IMPLEMENTING GREEN TECHNOLOGIES

Oksana Pozniak, Tetiana Kisera, Iryna Suvorova, Alina Shvets, Mykhailo Podrieza. "Planning the customer service process of a logistics company based on implementing green technologies". *The peculiarities of planning environmentally oriented customer service for a logistics company based on implementing "green" technologies are discussed in the article. It has been researched that planning is an integral part of the successful management of any company, especially in the logistics sector, where customer satisfaction and operational efficiency are key factors. Under modern conditions, to respond to customer requests, logistics companies must take into account the impact of their activities on the environment and implement appropriate methods to minimize the negative impact on the environment, and accordingly, the process of planning customer service in a logistics company should include an environmental component. Given this, the importance of integrating environmental factors and business processes at each stage of planning to ensure sustainable development of a logistics company based on forming a cyclic approach to planning environmentally oriented customer service is substantiated. The method of iterative planning that allows a logistics company not only to improve the quality of customer service but also to integrate environmental practices into its activities, which meets the modern requirements of sustainable development and social responsibility of business has been established. The developed model of environmentally-oriented planning of customer service combines business processes of logistics service and "green" technologies, transforms the operational efficiency of a logistics company in the context of sustainable development, substantiates the integration of environmentally sustainable solutions at all stages of the logistics chain - from initial planning to the final delivery of goods to consumers. To support the proposed model, the implementation of Power-to-X technology is recommended, which allows the conversion of excess renewable energy into energy specifically for logistics and transportation purposes. The implementation of this measure enables the logistics company to reduce emissions and increase energy efficiency, to form a comprehensive approach to the development and integration of environmentally friendly technologies in the company's logistics operations to increase efficiency and competitiveness. It is emphasized that the proposed model demonstrates a comprehensive approach to building a highly efficient and at the same time environmentally sustainable logistics system of the company by integrating innovative "green" technologies.*

Keywords*:* environmentally oriented planning, cyclical approach, logistics service, "green" technologies, logistics company, DSV

Оксана Позняк, Тетяна Кісера, Ірина Суворова, Аліна Щвець, Михайло Подреза. «Планування процесу обслуговування клієнтів логістичної компанії на основі впровадження «зелених» технологій». *В статті розглянуто особливості планування екологоорієнтованого обслуговування клієнтів логістичної компанії на основі впровадження «зелених» технологій. Досліджено, що планування є невід'ємною частиною успішного управління будь-якою компанією, особливо в секторі логістики, де задоволеність клієнтів і операційна ефективність є вже не є ключовими факторами, процес планування обслуговування клієнтів в логістичній компанії повинен включати екологічну складову. Враховуючи це, обгрунтовується важливість інтеграції екологічних факторів та бізнес процесів на кожному етапі планування для забезпечення сталого розвитку логістичної компанії га основі формування циклічного підходу до планування екологоорієнтованого обслуговування споживачів. Встановлено, що методика ітераційного планування дозволяє логістичній компанії не тільки підвищити якість обслуговування клієнтів, але й інтегрувати екологічні практики у свою діяльність, що відповідає сучасним вимогам сталого розвитку та соціальної відповідальності бізнесу. Розроблена модель екологоорієнтованого планування*

обслуговування клієнтів логістичної компанії поєднує бізнес процеси логістичного обслуговування та «зелені» технології, трансформує операційну ефективність логістичної компанії в контексті сталого розвитку, обґрунтовує інтеграцію екологічно стійких рішень на всіх етапах логістичного ланцюга – від початкового планування до кінцевої доставки товарів споживачам. Для підтримки запропонованої моделі рекомендовано впровадження технології Power-to-X. Реалізація даної технології дозволить логістичній компанії зменшити викиди та підвищити енергоефективність, сформувати комплексний підхід до розробки та інтеграції екологічно чистих технологій у логістичні операції компанії з метою підвищення ефективності та конкурентоспроможності. Наголошено, що запропонована модель демонструє комплексний підхід до побудови високоефективної та водночас екологічно стійкої логістичної системи компанії шляхом інтеграції інноваційних "зелених" технологій.

Ключові слова: екологоорієнтоване планування, циклічний підхід, логістичне обслуговування, «зелені» технології, логістична компанія, DSV.

Introduction. Under modern conditions, the way of serving consumers changes every day, and customers are increasingly interested not only in the type of services that logistics companies provide, but also in the way they are provided. With this in mind, the logistics company must prioritize the development of environmentally friendly customer service processes to meet current requirements as customer awareness of the environmental component of the process increases. The expansion of logistics operations has a negative impact on the environment, so it is imperative to prioritize the implementation of environmental principles and technologies in logistics processes, in particular in customer service processes, in order to guarantee the sustainable development of companies. When planning an effective environmentally oriented customer service system, a careful balance of excellent customer service with the ideas of sound environmental management and minimization of environmental impact is necessary. Leading logistics companies are actively involved in implementing ambitious programs to reduce environmental impact and promote decarbonization. Nevertheless, the complex coordination of environmentally-oriented procedures, incorporating advanced "green" technologies and taking into account the entire supply chain and product life cycle, still creates an unresolved issue that requires comprehensive scientific research.

Analysis of recent research and publications. Modern studies of this issue are focused mainly on specific elements, such as the study of logistics service processes [4], planning of logistics activities [5], the issue of the peculiarities of eco-oriented management at industrial enterprises in modern conditions [1], environmental studies, the introduction of alternative types of fuel, the development of infrastructure electric vehicles or the use of renewable energy sources in warehouses [7-8]. Such fragmentation determines the lack of a comprehensive approach to the formation of an ecologically oriented customer service planning system of a logistics company, which should take into account the entire chain of logistics customer service processes and provide a conceptual approach to planning the introduction of environmental principles and technologies into logistics processes and customer service processes.

Objectives statement. The purpose of the article is to develop a conceptual approach to planning the customer service process of a logistics company based on the implementation of "green" technologies.

Basic material and results. The customer service process of a logistics company is a set of interrelated actions and measures aimed at meeting customers' needs in transportation, warehousing, inventory

management, and related logistics services following agreed requirements and standards.

This is a flexible framework that can be customized and tailored to the unique needs of the logistics company and the environmentally conscious customer service (see Figure 1).

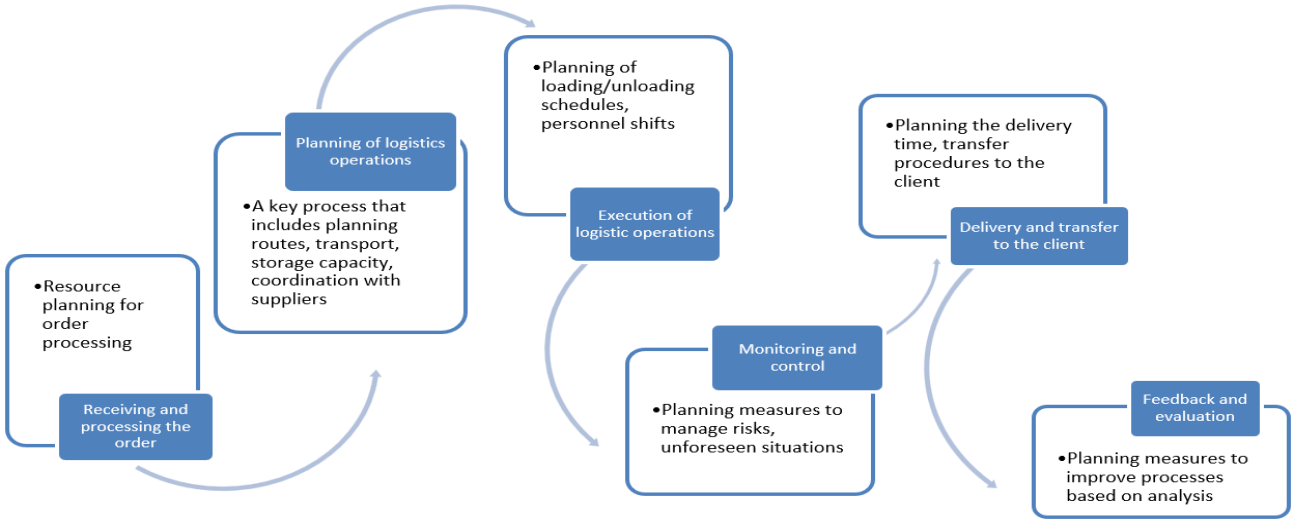

Figure 1 – The role of planning in the main processes of customer service
Source: compiled by the authors

Planning is an integral part of the successful management of any organization, especially in the logistics sector, where customer satisfaction and operational efficiency are key factors. However, in today's realities, companies must also consider the impact of their activities on the environment and implement appropriate methods to minimize the negative impact on the environment. Therefore, the process of planning customer service in a logistics company should include an environmental component to achieve environmental sustainability.

Environmental sustainability is an approach aimed at integrating environmental considerations into all aspects of an organization's activities or processes. This includes the minimization of the negative impact on the environment, the rational use of natural resources, and the introduction of environmentally friendly technologies and practices. Environmental sustainability involves comprehensive consideration of environmental factors at all stages of planning, production, operation, and disposal of products or services.

Achieving such environmental sustainability requires careful planning and implementation of relevant processes in the company's activities. In the context of environmentally oriented customer service in a logistics company, the term "process" covers the entire sequence of operations from the customer's order to the delivery of goods or services. This process should be planned and carried out taking into account environmental considerations and minimizing the harmful impact on the environment at each stage, forming a comprehensive planning system for environmentally-oriented customer service of the logistics company.

Given the importance of integrating environmental factors at each stage of planning to ensure the sustainable development of the company, it is advisable to apply a cyclical approach to planning environmentally safe customer service, which is depicted in Fig. 2.

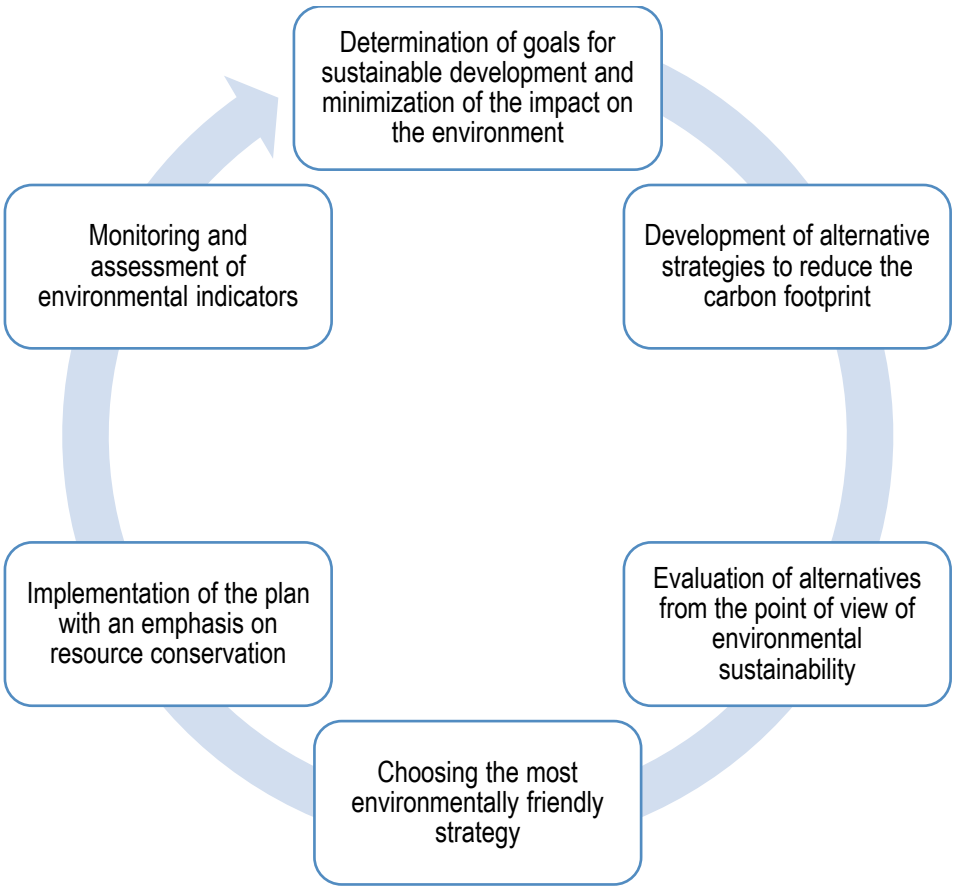

Figure 2 – Planning cycle of environmentally-oriented customer service
Source: compiled according to the data [4]

This scheme determines not only the sequence of actions in the cycle but also emphasizes the environmental aspect for the logistics company when planning customer service, namely:

1. Setting objectives for sustainable development and reducing environmental impact. During this phase, the company sets clear environmental goals and objectives that it aims to achieve in its operations. These include reducing emissions, optimizing resource usage, and minimizing the company's environmental footprint.

2. Exploring different approaches to minimize the carbon footprint. This step entails exploring and assessing various methods, advancements, and resolutions that can contribute to reducing carbon emissions and the overall environmental impact in the customer service process.

3. Considering different options based on their impact on the environment. During this stage, a thorough analysis and evaluation of different strategies and approaches are conducted to assess their potential impact on the environment, costs, effectiveness, and alignment with the company's environmental objectives.

4. Exploring the most eco-conscious approach. After a thorough assessment of the options, the most ideal approach is selected, prioritizing sustainable development principles, and minimizing harm to the environment.

5. Implementation of the plan with a focus on conserving resources. The selected approach is implemented, focusing on optimizing resource utilization, reducing waste, and implementing environmental conservation measures. We also monitor and assess environmental indicators.

The cycle is repeated to continually improve and find new, more effective approaches to environmentally focused customer service.

Such an iterative planning methodology allows a logistics company to improve the quality of customer service and integrate environmental practices into its operations, which meets the modern requirements of sustainable development and social responsibility of business.

The way companies plan their customer service processes within this environmentally conscious framework is central. To seamlessly combine both elements without compromising quality or efficiency; careful planning becomes imperative.

Planning an environmentally conscious customer service process requires a fundamental revision of existing paradigms. It begins by intertwining two often disparate areas: the effectiveness of business operations in the process of customer service in supply chains and environmental initiatives - to create a model in which these dimensions are harmoniously combined rather than contradicting each other, creating a synergistic effect.

When developing a customer service process for a logistics company with an emphasis on the environment, it is important to determine the principles of environmentally oriented logistics service planning:

1. Segment customers according to their environmental service needs and adjust logistics processes to effectively serve these segments.

2. Review the sustainability of the logistics system under the requirements of sustainable development and profitability for different customer segments.

3. Keep abreast of market trends and effectively manage demand planning for environmental services across the supply chain to ensure accurate forecasts and efficient resource allocation.

4. Effectively oversee environmental procurement practices to minimize environmental impact and optimize the cost-effectiveness of materials and services.

5. Improving environmentally friendly services that are more accessible to customers and accelerating the transition to green logistics practices.

6. Create a comprehensive environmental strategy for the entire logistics chain that improves the decision-making process at different levels and offers a transparent understanding of the movement of products, services, and information, taking into account environmental factors.

7. Utilize performance indicators that cover the entire logistics chain to measure the overall achievement of sustainability goals for end users.

By implementing these principles, a logistics company can effectively integrate environmental factors into its planning process and provide customers with the highest level of environmental services.

Consequently, logistics companies must take calculated risks to combine excellent customer service with sustainable practices to prepare for the environmentally conscious consumer. This marks the beginning of a transformational change as logistics companies shift their priorities from profitability to environmental awareness, establishing mutually beneficial partnerships with all supply chain stakeholders. Recognizing the synergistic effect of forming an environmentally oriented customer service, which leads to the transformation and adaptation of the business model and strategy of interaction with customers and partners, a logistics company should integrate innovative green technologies, firstly, into its own business processes of customer service, and secondly, involve partners in the use of green technologies, forming a green supply chain ecosystem.

Leading logistics companies act as pioneers who shape the development trends not only of their own company but also the development trends of the entire logistics industry. One such organization is DSV, a logistics company that makes extensive use of

advanced technologies, especially environmentally friendly ones, to improve customer service processes. The growing importance of environmentally-oriented technologies in today's world requires studying their impact on supply chain management and planning, as well as appropriate adjustments. Therefore, there is a need to introduce a system approach to the environmentally oriented customer service process of the company, which forms an end-to-end vision of the use of green technologies to ensure logistics service processes [35].

The proposed model of environmentally oriented planning of customer service processes (see Figure 3) determines an intricate logistics process in the company that encompasses several phases of the transportation of products from the source to the ultimate receiver. The upper section illustrates the overall sequence of stages: planning, inbound (transportation to the warehouse), storage, outbound (distribution), and delivery to the destination. Each stage includes a comprehensive account of the specific processes involved, including cargo pickup, customs clearance, warehousing, order picking, and ultimate delivery to the consumer.

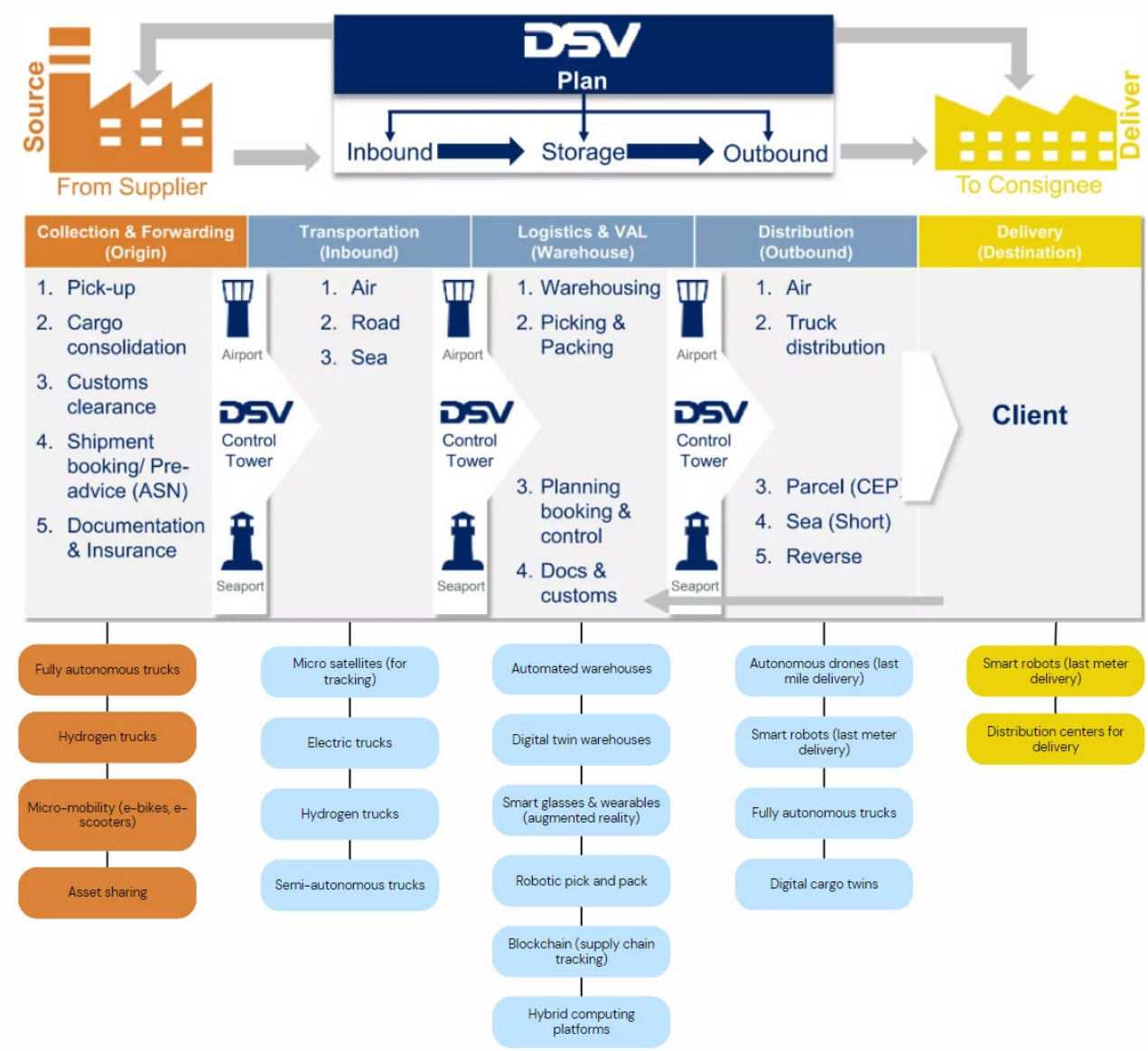

Figure 3 – Model of environmentally oriented planning of customer service processes for DSV company

Source: compiled according to the data [2]

Furthermore, Figure 3 illustrates a range of cutting-edge and environmentally sustainable technologies that may be implemented at every level of the logistics chain to enhance both the efficiency and ecological compatibility of the operations.

Transportation services include completely autonomous and hydrogen-powered trucks, and electric cars, as well as asset-sharing and micromobility solutions. Warehouses can employ automated and digital replica warehouses, robotic picking systems, augmented reality technology, blockchain for tracking purposes, and hybrid computing platforms.

The ultimate goal is to develop autonomous drones, intelligent delivery robots, and completely automated vehicles for delivery. Advanced technologies, including microsatellites, are also demonstrated to track and monitor at every level.

The proposed model provides a comprehensive view of the logistics and distribution process for DSV. The process outlined covers the various stages involved in managing the flow of goods, from receiving them from suppliers to storing them, distributing them, and ultimately delivering them to the intended recipient.

The fundamental process flow is illustrated above, showcasing the input, storage, and output steps. Specific activities are listed under each step, including pickup, customs clearance, warehousing, and various methods of transportation for final delivery, such as air, truck, and parcel service.

The process starts with the initial phase of Inbound logistics, which involves the gathering and transportation of goods from suppliers. During this stage, various operations are carried out, including cargo selection, consolidation, customs clearance, shipment booking, and insurance.

Next comes the Storage stage, where the focus is on showcasing a warehouse for the temporary storage of goods.

The Outbound stage of the supply chain focuses on the distribution and shipment of goods to customers. This is where the process of loading vehicles, planning routes, and maintaining control occurs.

The last step involves delivering the goods to the final recipient through different methods such as air transportation, road transport, or courier service.

Moreover, the developed model demonstrates the potential for the integration of advanced environmental technologies at various stages of planning customer service processes of a logistics company with the help of innovative technologies and environmentally friendly solutions and defines the prospects for providing logistics processes with "green" technologies, such as fully autonomous trucks, hydrogen/ electric trucks, micro-mobility solutions, automated warehouses, last-mile delivery drones, smart robots, digital twins, blockchain for supply chain tracking and hybrid computing platforms.

The model is aimed at researching the integration of sustainable solutions into various stages of the customer service process to improve operational processes by implementing appropriate green technologies.

Thus, the model provides a comprehensive reflection of the modern logistics process, including promising environmental solutions to increase efficiency, sustainability, and quality of customer service. The model demonstrates how the integration of advanced digital and green technologies can revolutionize conventional logistics operations, resulting in a highly efficient and environmentally sustainable supply chain.

Environmentally oriented planning of customer service processes focuses the logistics company on the effective use of the investment in the development of "green" technologies, which potentially leads to performance improvements, competitive

advantages, and reputational benefits, such as:

1. Maximization of cost-effectiveness. Green technologies can help improve operational efficiency, leading to long-term cost savings.

2. Improved reputation and increased market share. As consumers become more aware of the environmental impact of the brands they support, companies that actively participate in green initiatives can gain significant market favor and contribute to their success.

3. Future-proofing is critical in an ever-changing global regulatory landscape. By staying ahead of the curve and adopting new rules early on, you can minimize any potential disruptions.

4. Innovation catalyst. A strong focus on the environment can inspire other creative endeavors, leading to improvements in previously unexplored methods of delivering products and services.

Despite the optimistic appearance of this landscape, it would be unwise to overlook the possible challenges that lie ahead. The shift towards more environmentally friendly alternatives can present certain challenges, resulting in several potential risks:

1) Investment Costs: Transition may involve a substantial initial investment, often necessitating significant changes to current systems.

2) Technological complexity: Frequently, the transition entails intricate operations that necessitate specialized expertise that can be challenging to identify and acquire.

3) Potential for Failure: Just like any new system, there is always a possibility of encountering challenges, whether it is related to integration issues or falling short of expectations.

4) Uncertainty surrounding regulations. Similar to a financial advisor, firms aim to adhere to existing legislation. However, the presence of uncertain future changes poses considerable risks that can negatively impact ROI calculations.

Based on the data studied and the company's goals, investments in the development of environmentally friendly green technologies were proposed, which are consistent with the company's future forecasts and solve the problem. One of these technologies is Power-to-X, which affects the entire supply chain and is environmentally sustainable, which is a decisive factor for customers (see Fig. 4) [3].

DSV has a separate structural division for the implementation of innovative projects - the DSV Innovation Center. This dedicated team monitors development trends and technologies, collaborates with both internal and external stakeholders, validates concepts, develops financial business cases and oversees projects across the network, ensuring that DSV remains at the forefront of industry advancements. It is the Innovation Center that must develop a plan for the implementation of environmental projects to ensure customer service processes. In most cases, these are infrastructure projects, the implementation of which is determined by the following factors:

1. Increasing attention to environmental problems. Global concern about climate change and environmental degradation has led to a sharp increase in demand for environmentally friendly goods and services.

2. Regulatory obligations in several countries require companies to minimize their impact on the environment, encouraging logistics operators to make green decisions.

3. Financial benefits. Green technology can provide logistics service providers with several economic benefits, including:

- reduction of energy and fuel costs;
- reduction of emissions of harmful substances;
- increasing the company's reputation.

4. Efficiency and optimization of processes can be achieved through the implementation of "green" technologies, such as autonomous flying drones and manned vehicles. These technologies play a critical role in improving delivery and

warehouse operations, especially for logistics organizations.

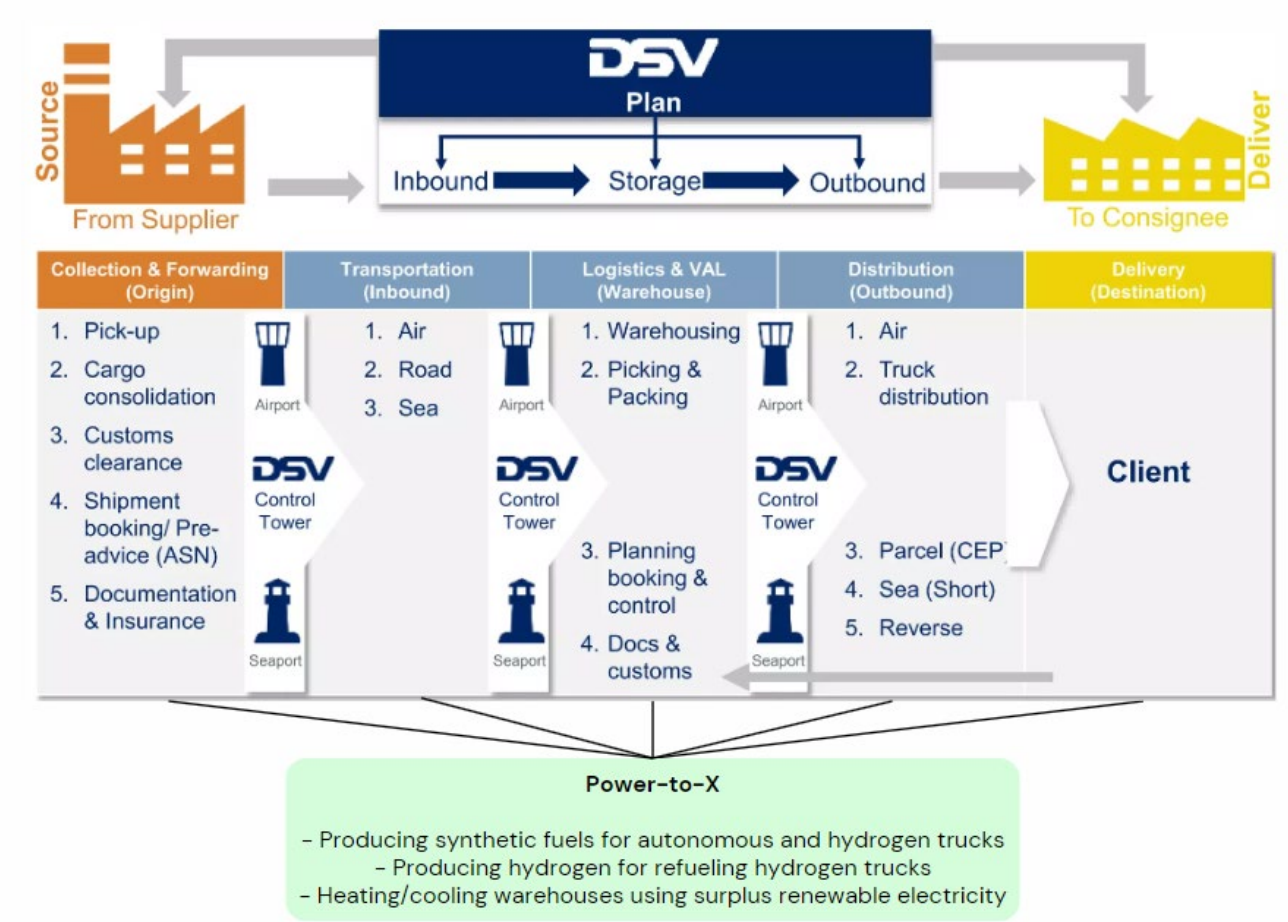

Figure 4 – DSV's logistics flow with the "Power-to-X" concept
Source: compiled according to the data [6]

5. DSV is transforming its operations by integrating artificial intelligence and digital platforms to increase productivity and optimize mergers and acquisitions, thus significantly transforming logistics processes.

6. Increase supply chain visibility: Using digital technology to connect suppliers and customers at every stage of the delivery process can improve supply chain visibility, which is a key aspect in today's world.

Based on SWOT analysis, which is presented in Table 1, the most important factors that should be taken into account when planning, designing, and implementing logistics infrastructure greening projects to ensure an environmentally-oriented customer service process are determined.

The SWOT analysis findings indicate that the integration of "green" technology into the operations of logistics provider DSV has identified numerous strengths that may be effectively applied. An optimal setting for successful implementation is established by the increasing demand for eco-friendly products and services, legislative mandates to reduce environmental impact, and the financial benefits of green technology. Moreover, DSV's history of pioneering advancements, namely in the use of digital platforms and artificial intelligence, demonstrates its willingness to embrace technological progress. Nevertheless, it is necessary to take into account the shortcomings of the project. To enhance the success of an endeavor, it is important to take

into account these aspects in both the planning and execution stages. With its strengths and future prospects, the project has the capacity to establish dominance in the logistics and logistics infrastructure industry. Nevertheless, it is crucial to anticipate and be ready for any possible obstacles that can occur.

Table 1 – Analysis of strengths and weaknesses of logistics infrastructure greening projects to ensure an environmentally-oriented customer service process

Strengths	**Weaknesses**
1. DSV is a global logistics provider that sets trends in environmentally friendly customer service. 2. Implementation of sustainable development strategy, and sustainable development goals. 3. Development of a "green" supply chain strategy, and implementation of "green" logistics services in the company's business model. 4. Growing demand for "green" products and services among the company's customers 5. Experience of DSV in implementing innovations, including "green" projects 6. Dissemination of experience in the implementation of "green" technologies, and involvement of partners who also implement the goals of sustainable development.	1. Significant investments and resources for the introduction of new "green" technologies. 2. Long payback period of "green" projects. 3. Risk of employees' rejection or non-adaptation to new technologies.
Opportunities	**Threats**
1. Expanding the use of "green" technologies can increase environmental responsibility and competitiveness. 2. Active innovation activities and the presence of the DSV innovation center allow to remain at the forefront of the industry. 3. Improving the company's image	1. The possibility of changes in legislation or regulatory requirements regarding the use of environmental technologies. 2. Competition and pressure to reduce costs can become an obstacle to the effective adoption of new technologies. 3. Unforeseen technological risks

Source: developed by the authors

The technology proposed to ensure the environmental sustainability of logistics processes for DSV is the implementation of Power-to-X technology. The essence of the technology is that excess electricity obtained during periods of excess production of renewable energy sources over consumption is used to produce fuel (Power-to-Fuel), hydrogen and methane (Power-to-Gas), ammonia and methanol (Power) -to -Liquid) or other chemicals.

Potentially, the introduction of such technology for the DSV company is promising, since it allows it to join the ecosystem of the "Bringing the Era of Electricity" concept, which describes a world in which the main form of energy is inexpensive and practically inexhaustible electrical energy from renewable sources. The key to implementation is comprehensive electrification, networking, and automation of all sectors of the economy and infrastructure, that is, an ecosystem is formed where the negative impact on the environment is minimal.

Planning the implementation of ecologically oriented technologies in a logistics company requires a detailed development of the work structure, which is summarized in Table 2.

Table 2 – Hierarchical structure of the project work on the implementation of "green" technologies in the activities of the logistics provider

Task code	Activity	Description
1	***Preparatory stage***	
1	***2***	3
1.1	Determination of strategic goals for the introduction of "green" technologies in logistics activities	This stage involves defining strategic goals for implementing "green" technologies in logistics activities, including reducing the carbon footprint, increasing resource efficiency, environmental improvement, and enhancing competitiveness.
1.2	Market analysis of "green" technologies and Power-to-X	At this stage, an analysis of the market for "green" technologies and Power-to-X is carried out in order to determine the best solutions for the logistics provider.
1.3	Determining the amounts and types of energy that can be converted using Power-to-X	Identify the volumes and types of energy that can be converted using Power-to-X technology, aligning them with the logistics provider's requirements.
1.4	Signing an agreement with Power-to-X technology developers	At this stage, an agreement is signed with the developers of Power-to-X technologies, in order to ensure the implementation of the project.
2	***Risk and security management***	
2.1	Identification of potential risks associated with the implementation of Power-to-X.	Assess potential risks associated with implementing Power-to-X technology.
2.2	Development and implementation of a risk management plan.	Create and execute a comprehensive risk management plan to mitigate identified risks.
3	***Documentation and approval***	
3.1	Development of technical documentation for Power-to-X implementation	Create technical documentation for Power-to-X implementation, encompassing plans, specifications, work schedules, and cost estimates.
3.2	Approval of plans and specifications using "green" technologies	Plans and specifications using "green" technologies are approved by the management of the logistics provider.
3.3	Review and approval of the territory plan for the placement of energy equipment	The plan of the territory for the placement of energy equipment is reviewed and approved by the management of the logistics provider.
4	***Financing and Investments***	
4.1	Development of a financial plan	Develop a comprehensive financial plan detailing the costs and funding required for Power-to-X implementation.
4.2	Financial approval of the project and obtaining the necessary funds for implementation	The Power-to-X implementation project is financially approved by the management of the logistics provider, after which the logistics provider receives the necessary funds for the implementation of the project.
5	***Ordering equipment and materials***	
5.1	Creation of copies of technical plans and specifications	Copies of technical plans and specifications are created for future use.
5.2	Choice of technology and suppliers	Choose appropriate technology and suppliers for Power-to-X equipment procurement.

End of table 2

5.3	Ordering the necessary equipment for energy conversion using Power-to-X technology	The necessary equipment for energy conversion using the Power-to-X technology is being ordered from suppliers.
6	***Construction stage***	
6.1	Development of the work schedule and determination of rates for construction	A work schedule is developed and rates for construction are determined.
6.2	Obtaining permits for construction and classification of files	Building permits are obtained and files are classified.
6.3	Carrying out construction works and installation of energy equipment	Construction works and installation of energy equipment are being carried out.
7	***Testing and Debugging***	
7.1	Conducting tests and checking the effectiveness of Power-to-X technology	Tests are conducted and the effectiveness of Power-to-X technology is verified.
7.2	Integration with Existing Systems	Integrate Power-to-X systems with existing logistics systems.
7.3	Optimization of system operation taking into account the obtained results	The operation of the system is optimized taking into account the obtained results.
7.4	Obtaining the necessary certificates and permits for operation	Acquire necessary certificates and operational permits for the system's functionality.
8	***Operation and monitoring***	
8.1	Starting the Power-to-X system and transitioning to its full operation	At this stage, the Power-to-X system starts up and goes into full operation.
8.2	Definition of the efficiency and environmental impact monitoring system	A system for monitoring the efficiency and environmental impact of the Power-to-X system is being implemented.
8.3	Conducting regular maintenance and identifying opportunities for improvement	Regular maintenance of the Power-to-X system is carried out and opportunities for its improvement are identified.

Source: developed by the author – T. Kisera

The implementation of innovative projects of this type requires careful development and implementation, therefore the structure of works indicated in Table 2 is only an approximate conceptual procedure that can be adjusted according to changes in the external and internal environment.

Conclusions. The logistics company's customer service activities have a significant negative impact on the environment, and to ensure that the processes are carried out using more environmentally friendly technologies, the logistics company should give priority to planning the implementation of environmental principles and technologies in the logistics and customer service processes. The proposed model demonstrates a comprehensive approach to building a highly efficient and at the same time environmentally sustainable logistics system of the DSV company by integrating innovative green energy technologies. This fully corresponds to the current world trends of decarbonization and helps to significantly increase the competitive position of the company in the market of ecologically responsible logistics. This identifies new directions for further research and opportunities for creating "green" supply chain ecosystems.

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TRANSPORT SYSTEM OF AZERBAIJAN: WHAT'S HAPPENING NOW AND WHAT'S NEXT?

Bugayko Dmytro, Mirzayev Fuad Murvat, Garibli Gulgun Mushviq. Eynullazadeh Kazim. "Transport system of Azerbaijan: what's happening now and what's next?" *The article presents a comprehensive analysis of the transformations that have occurred in Azerbaijan's transport sector over the past decade, offering insights into the current state of the transport system. It is widely acknowledged that the transport sector plays a pivotal role in enhancing a country's international recognition and strengthening its global position. It follows that the advancement of this sector of the economy represents a fundamental strategic objective for any state. The article reviews and analyses the current state of Azerbaijan's transport system and the measures taken to improve it, as well as the investments made in this field. Furthermore, in*

consideration of Azerbaijan's current status as a transit nation, the article examined the transportation routes of international corridors traversing the country and their operational efficiency. Also, the article presents a comparative analysis of the cargo and passenger transportation potential of Azerbaijan's transport system over the past decade across various modes of transportation. In order to ascertain the efficacy of the transportation system, the final revenues and expenditures were subjected to analysis, resulting in the calculation of the profit (or loss) for the various modes of transport.

***Keywords**:* Azerbaijan's transport system, transport corridors, freight, passenger transportation, transport infrastructure

Бугайко Дмитро, Мірзаєв Фуад Мурват, Гаріблі Гулгун Мушвік. Ейнулазаде Казім. «Транспортна система Азербайджану: що відбувається зараз і що далі?». *Стаття представляє комплексний аналіз трансформацій, які відбулися в транспортному секторі Азербайджану за останнє десятиліття, пропонуючи розуміння поточного стану транспортної системи. Загальновизнано, що транспортний сектор відіграє ключову роль у підвищенні міжнародного визнання країни та зміцненні її глобальної позиції. З цього випливає, що розвиток цього сектора економіки є фундаментальною стратегічною метою будь-якої держави. У статті розглядається та аналізується поточний стан транспортної системи Азербайджану та заходи, вжиті для її покращення, а також інвестиції, зроблені в цій галузі. Крім того, з огляду на поточний статус Азербайджану як транзитної держави, у статті досліджено транспортні маршрути міжнародних коридорів, що проходять через країну, та їх ефективність. Також у статті представлено порівняльний аналіз вантажо-пасажирського потенціалу транспортної системи Азербайджану за останнє десятиліття різними видами транспорту. Для того, щоб переконатися в ефективності транспортної системи, кінцеві доходи та витрати були піддані аналізу, в результаті якого розраховано прибуток (або збиток) для різних видів транспорту.*

Ключові слова: транспортна система Азербайджану, транспортні коридори, вантажні, пасажирські перевезення, транспортна інфраструктура..

Introduction. The term "transport" is used to describe a service area that ensures the transportation of people and cargo from one place to another. The transport sector occupies a distinctive position in the rapid and comprehensive development of the country's economy. The primary objective of the transport sector is to facilitate the safe, expedient, and cost-effective movement of goods and people [1]. In order to achieve this objective, it is essential that each country's transport system is effectively established. The term "transport system" is used to describe the collective set of different types of transport and transport infrastructure, regardless of the form of ownership and subordination.

The current state of the transport system of the Republic of Azerbaijan was investigated in detail in the conducted research. Furthermore, the volumes of both cargo transportation and passenger transportation, the obtained incomes and incurred expenses were comparatively analysed by means of economic-statistical methods for various types of transport. The principal objective of the research is to document the changes that have occurred in Azerbaijan's transport sector over the past decade and to identify potential future developments. In the course of the investigation, the official data provided by the State Statistics Committee of the Republic of Azerbaijan, Azerbaijan Railways CJSC, Baku Metro CJSC, AZAL CJSC, "Baku International Sea Trade Port" CJSC and other relevant institutions were used as the basis for analysis.

The role of the transport system in the economy of Azerbaijan. The advancement of the transport system is of significant consequence for the Republic of Azerbaijan. The experience of developed countries demonstrates that the modern transport

system, which plays a pivotal role in the expansion of economic relations between countries worldwide and the acceleration of integrative processes, has become a primary component of the national economy.

The transport system of Azerbaijan is a comprehensive network that encompasses all existing modes of transportation and facilitates interaction between them.

Railway transport constitutes an integral component of the transport system. Railway transport plays an integral role in the transport system of Azerbaijan. This mode of transportation is primarily utilized for the conveyance of substantial volumes of cargo, including that destined for transshipment [2]. The most transported cargo by railway includes oil products, grain, chemical and mineral fertilisers, building materials, ferrous metals, coal and other types of cargo. Additionally, a portion of the country's domestic passenger transportation is conducted via rail. Railway transport in Azerbaijan is wholly owned by the state.

The field of road transport is a significant aspect of the transportation sector in Azerbaijan. In Azerbaijan, road transport is primarily employed for the conveyance of both passengers and short-haul cargo. In the transport system of Azerbaijan, road transport plays the dominant role in both the movement of passengers and the transportation of goods. This is primarily due to the fact that the country's territory is relatively limited, thereby rendering road transport a more efficient mode of transportation than other forms of transport.

The primary function of ***sea transport*** is the conveyance of transit cargo. Given the relatively slow pace of travel associated with this mode of transportation, it is not a prominent contributor to the field of passenger transportation. The majority of coal, oil and oil products, and vehicles are transported by sea. The state also exercises control over maritime transport in Azerbaijan.

The field of ***air transport*** is a distinct and specialized area of study. Air transport is distinguished from other modes of transportation by two key characteristics: high speed and safety. In other words, this mode of transportation allows for the expedient delivery of cargo and passengers to any location worldwide. In Azerbaijan, the state is responsible for the provision of passenger air transportation, while the operation of cargo flights is outsourced to a private airline. It is crucial to recognise that the civil aviation enterprises in Azerbaijan are fully compliant with the standards set forth by the International Civil Aviation Organization (ICAO) [3].

The transportation of goods and materials via ***pipeline*** is another key aspect of the country's logistics infrastructure. The advancement of pipeline transport in Azerbaijan is inextricably linked to the growth of the oil and gas industry. Pipeline transport is fully state-owned.

In 2023, Azerbaijan's gross domestic product (GDP) grew by 1.1 percent, reaching 123,0 billion manats. Transport and storage contributed 7637,0 million manats, or 6,2 percent of GDP, to this growth. This represents a 0,2 percent increase from the previous year (Graph 1) [4].

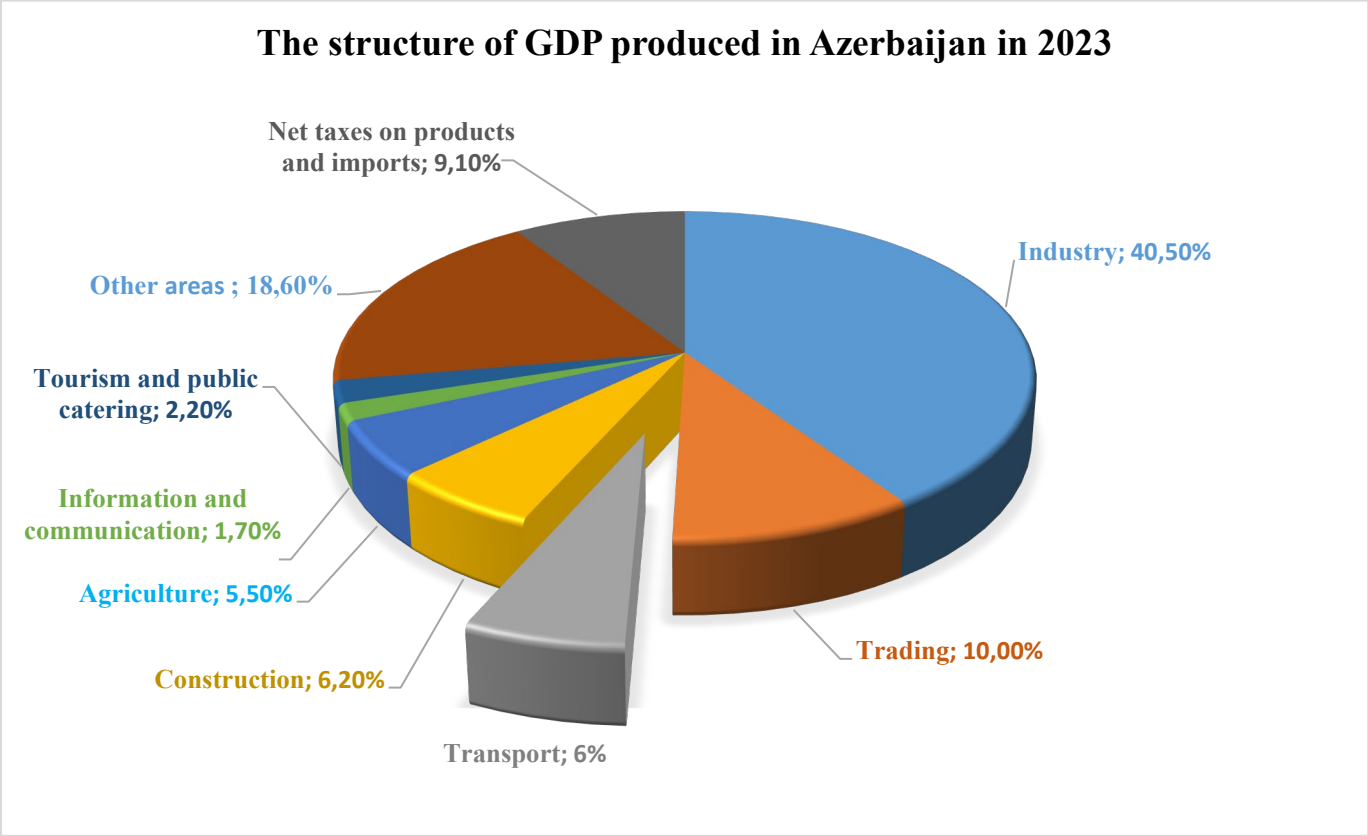


Figure 1 – The structure of GDP produced in Azerbaijan in 2023
Source: Compiled by the authors based on the data of the State Statistics Committee of the Republic of Azerbaijan

The 2023 state budget of the Republic of Azerbaijan allocated a total of 366 million manats to the transport sector. In 2022, the figure was 217 million manats. The 68% increase in funds allocated to the transport sector is indicative of the government's heightened attention to this area [5].

In the 2019 Global Competitiveness Index published by the Davos Economic Forum, Azerbaijan was ranked 11th among 141 countries in terms of the efficiency of railway services, 12th in terms of the efficiency of air transport services, 25th in terms of the efficiency of seaport services, and 27th in terms of the quality of road infrastructure [6].

In recent years, a considerable number of infrastructure projects and social programmes have been initiated in Azerbaijan. These include initiatives pertaining to the reconstruction of road infrastructure, which is regarded as a crucial component of social infrastructure. The construction of new infrastructure and the substantial refurbishment of existing infrastructure have been successfully pursued. Additionally, a road and transport infrastructure that meets contemporary standards is being constructed in territories liberated from occupation as part of a comprehensive construction project.

So, only in these areas during the last 4 years:

- A new road, the Fuzuli-Shusha highway (also known as the Zafar Road), measuring 101 km in length, has been constructed and is now in use;
- The Zangilan-Horadiz highway, which is 24 km in length and comprises four to six lanes, is currently under construction;
- The construction of the Hadrut-Jabrayil-Shukurbeyli highway, with a length of 39,7 km, is nearing completion;

• The 44,5 km long Barda-Aghdam highway was constructed and subsequently brought into use;

• The restoration of the Tartar-Chayli-Suguvushan-Talish highway, which spans a distance of 29 kilometres, was completed;

• The construction of the Horadiz-Aghband railway line, which spans 100 kilometers, has reached a point where 45% of the planned works have been completed;

• The Barda-Aghdam railway project has reached a significant milestone, with 90% of the works already completed;

• The construction of new airports in Fuzuli and Zangilan has resulted in their subsequent inauguration and operationalization;

• The construction of a new terminal at Lachin airport is currently in progress [7].

The implementation of these projects necessitates a substantial capital investment. In Azerbaijan, the majority of funding for transport infrastructure projects is sourced from internal investments. Consequently, 97,5% (equivalent to 4.500,3 million manats) of the capital invested in 2022 can be attributed to domestic sources, while the remaining 2,5% (113,1 million manats) can be classified as foreign investment.

Table 1 – Investments directed to the transport sector in Azerbaijan

Investments directed to the transport sector in Azerbaijan, million manats					
	2018	2019	2020	2021	2022
Total	**1.922,8**	**2.189,2**	**2.091,6**	**2.857,3**	**4.613,4**
Railway transport	7,1	1,2	1,2	0,4	0,1
Road transport	129,8	235,8	266,8	109,2	108,6
Pipeline	168,3	140,5	121,8	57,3	99,8
Water transport	115,4	98,4	53,3	40,3	31,5
Air transport	39,4	33,7	109,7	147,1	89,3
Warehouse economy and auxiliary transport activities	1.462,8	1.679,6	1.538,8	2.503,0	4.284,1

Source: Compiled by the authors based on the data of the State Statistics Committee of the Republic of Azerbaijan

Table 1 presents a quantitative analysis of the investment volume in the transport sector over the period 2018-2022. As can be seen from the table, the majority of funds directed to this sector in recent times have been invested in warehousing and auxiliary transport activities. In 2018 and 2019, 76% of funds were invested in this area, while in 2020 this figure was 73,5%. In both 2021 and 2022, the proportion of funds invested in this sector reached 87,6% and 92,9% respectively. This illustrates the prioritisation of infrastructure development within the country.

Azerbaijan as part of the international transport system.

Azerbaijan's status as a transit country is reinforced by its favourable geographical position and the efficacy of the policies implemented to facilitate transit. Consequently, as a consequence of the sustained and strategic decisions taken many years ago to enhance the transport infrastructure in Azerbaijan, the country is now equipped to undertake any form of transportation, to receive, store and dispatch all types of cargo. Consequently, Azerbaijan, situated at the confluence of international transport routes, has emerged as a dominant player within the region.

The data provided by the State Statistics Committee of the Republic of Azerbaijan indicates that during the initial three-month period of 2024, 3.607,4 thousand tons, representing 45,2 percent of the total cargo transported through the designated transport corridors, was transported via

railway. Road transport accounted for 2.527,5 thousand tons, or 31,7 percent, while sea transport accounted for 1.845,7 thousand tons, or 23,1 percent. A total of 60,2 percent, or 4.808,0 thousand tons, of these cargoes were classified as transit cargo.

North-South Transport Corridor. The North-South International Transport Corridor was established on 12 September 2000, following the signing of an agreement between the governments of Russia, Iran and India [8]. The Republic of Azerbaijan subsequently ratified this agreement in accordance with the provisions set out in the Law of the Republic of Azerbaijan on joining the "North-South" International Transport Corridor Agreement, which was enacted on 20 September 2005 [9].

The North-South transport corridor is designed primarily for the delivery of goods from India and the Iranian Gulf region to Russia, Western Europe, the Baltic and Scandinavian countries. Map 1 illustrates that this corridor offers a significant advantage over other routes in terms of transit distance and transit time, which are reduced by two to three times. The North-South Transport Corridor allows for a reduction in transit time from 45 to 60 days to 20 to 25 days, when compared to other routes that involve the Persian Gulf, the Indian Ocean, the Suez Canal, the Mediterranean Sea and the Baltic Sea [10].

Route: Europe-Russia-Azerbaijan-Iran-Persian Gulf-India

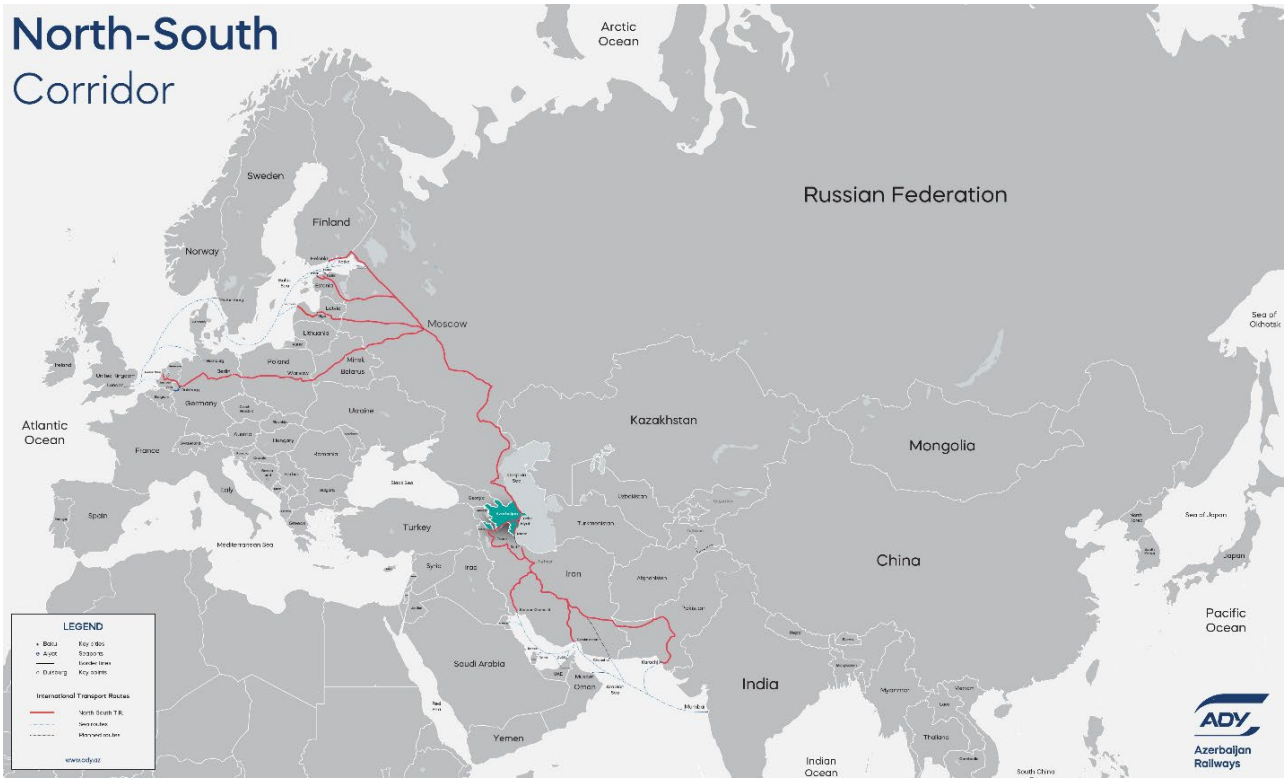


Figure 2 – North-South Transport Corridor

Source: https://freight.ady.az/beynelxalq-dehlizler/simal-cenub-neqliyyat-dehlizi

The North-South transport corridor has 3 main routes:

Western Route. The route designated as the "West" route, which traverses Russia and Azerbaijan along the western coast of the Caspian Sea, spans approximately 5,100 km and offers the most optimal connectivity with the railways and highways of the South Caucasus.

Trans-caspian route. The distance traversed by the Trans-Caspian route across the Caspian Sea is approximately 4,900 km.

Eastern Route. The eastern coast of the Caspian Sea is traversed by the "East" route,

which passes through Kazakhstan and Turkmenistan. This route is approximately 6,100 km in length [11].

In the period between January and March 2024, the volume of cargo transported through this corridor was 2.432,1 thousand tons [4].

East-West Transport Corridor

The East-West (Middle Corridor) or Trans-Caspian International Transport Route (TCITR) is a key conduit for the movement of goods from China to Turkey and, subsequently, to European Union countries, and vice versa (Map 2). The corridor was established in 2014 with the participation of the railway, shipping and port administrations of Azerbaijan, Georgia, Kazakhstan, Ukraine and Turkey. The average transit time for a train travelling along this corridor from China to Europe is 10-12 days. This constitutes one of the principal advantages of the transport corridor [10].

Cargo is transported to Europe via the Middle Corridor in two distinct directions:

1. The route traverses the ports of Poti and Batumi in Georgia;

2. The route is traversed by the Baku-Tbilisi-Kars railway.

The Baku-Tbilisi-Kars project, which was initiated by Azerbaijan, has the objective of increasing the volume of transit operations by reducing the costs of cargo transportation through the Middle Corridor. The "Karabakh Declaration" was signed by the member states of the 2024 Organization of Turkic States with the objective of reinforcing regional integration through the Trans-Caspian International Transport Route, optimising transport operations and customs procedures, and guaranteeing the rapid digitisation of processes. The document addresses a number of key issues, including the modernisation of the Baku-Tbilisi-Kars railway line, the restoration of the extensive energy potential in the Turkic states, the project of mutual coordination of Azerbaijan-Kazakhstan-Uzbekistan energy systems, and numerous other matters. Collectively, these elements illustrate the potential and advantages of Azerbaijan as a transport and logistics network [12].

Route: China-Kazakhstan-Caspian Sea-Azerbaijan-Georgia-Turkey/Black Sea-Europe

Figure 3 – East-West Transport Corridor

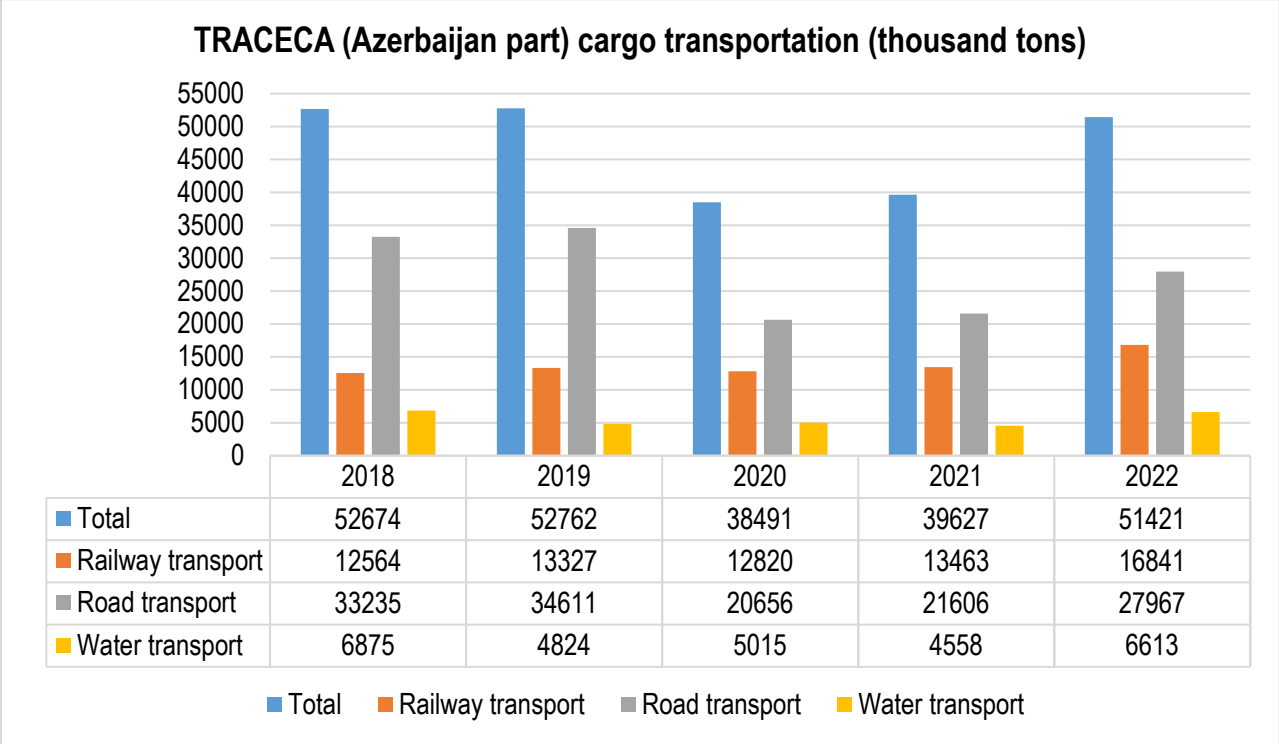
Source: https://freight.ady.az/beynelxalq-dehlizler/serq-qerb-neqliyyat-dehlizi

As of 2020, the regular shipping of containers from Turkey to China across the Middle Corridor is conducted on a biweekly basis. In 2023, the volume of cargo transported through this corridor reached 2,75 million tons, representing an 86% increase compared to the previous year. In the initial three-month period of 2024, the volume of cargo transported via the East-West transport corridor was recorded at 3.763,3 thousand tons.

TRACECA (Europe-Caucasus-Asia Transport Corridor)

The Trans-European Transport Consortium (TRACECA) is an East-West corridor created by member countries under the leadership of the European Union (EU) with the objective of connecting the countries of the Commonwealth of Independent States to Europe through the Caucasus or the Black Sea. The decision to implement the TRACECA project was made at a conference held in Brussels in May 1993 [13]. The TRACECA initiative is viewed as a means of restoring the historic Silk Road, one of the world's oldest trade routes.

In 2022, the volume of cargo transported in the Azerbaijani section of the Europe-Caucasus-Asia transport corridor reached 51.420,6 thousand tons, while the cargo turnover reached 12.648,9 million tons-km. These figures represent a 29,8 percent and 31,9 percent increase, respectively, compared to the same period of the previous year [4].



	2018	2019	2020	2021	2022
Total	52674	52762	38491	39627	51421
Railway transport	12564	13327	12820	13463	16841
Road transport	33235	34611	20656	21606	27967
Water transport	6875	4824	5015	4558	6613

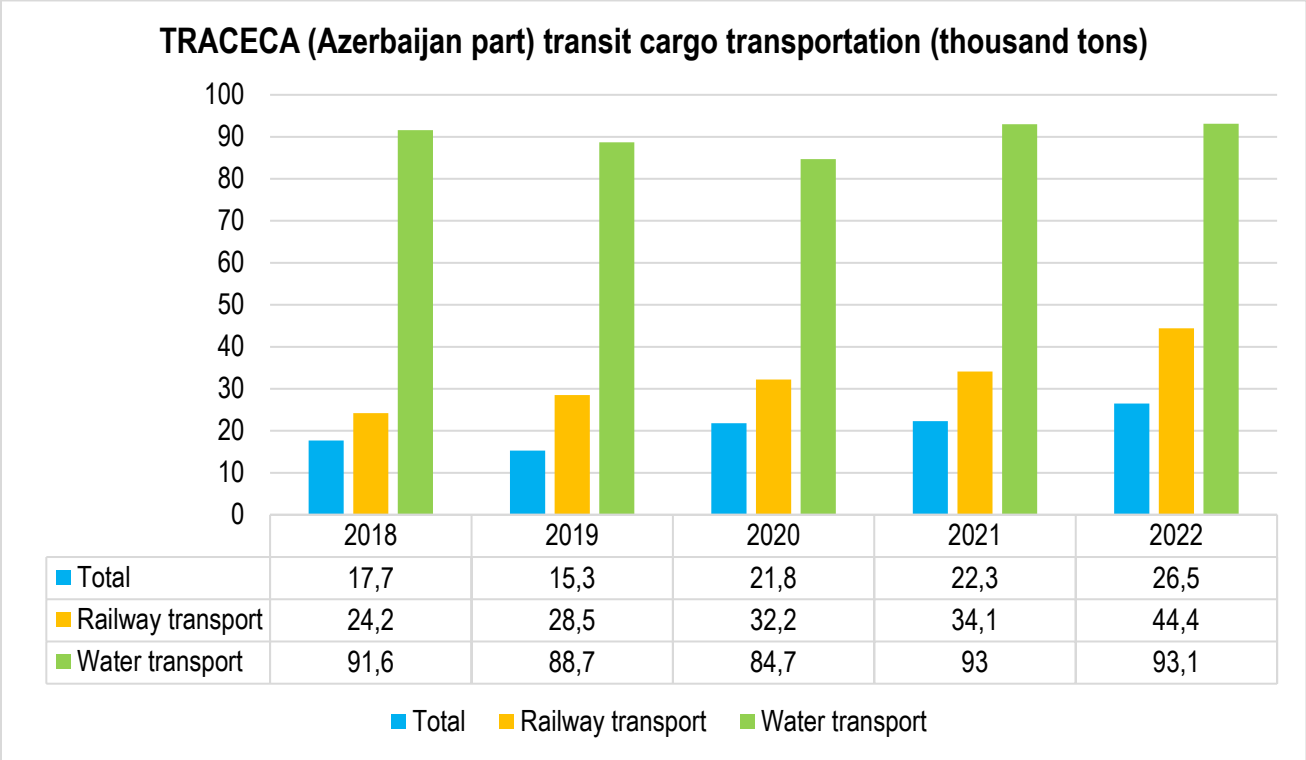
Figure 4 – TRACECA (Azerbaijan part) cargo transportation (thousand tons)

Source: Compiled by the authors based on the data of the State Statistics Committee of the Republic of Azerbaijan

As illustrated in Chart 2, the greatest quantity of cargo was transported through this corridor between 2018 and 2022, with the highest volume occurring in 2019. It is important to acknowledge that the volume of transportation, particularly in the context of road transport, has experienced a notable decline during the course of the ongoing pandemic. This can be attributed to the closure of the land borders between the countries during that period. In 2022, 54,4% of

the total cargo was transported by road, 32,7% by rail, and 12.9% by sea.

The mean proportion of cargo transported through the corridor that is transit cargo is 21%. Consequently, 26,5 percent, or 13.634,6 thousand tons, of the transported goods in 2022 were transit cargoes.



	2018	2019	2020	2021	2022
Total	17,7	15,3	21,8	22,3	26,5
Railway transport	24,2	28,5	32,2	34,1	44,4
Water transport	91,6	88,7	84,7	93	93,1

Figure 5 – TRACECA (Azerbaijan part) transit cargo transportation (thousand tons)
Source: Compiled by the authors based on the data of the State Statistics Committee of the Republic of Azerbaijan

As illustrated in Chart 3, the predominant modes of transit cargo transportation through TRACECA are rail and sea transport. The proportion of transit cargo among all cargo transported along the corridor increased by 8,8% between 2018 and 2022. The most substantial growth was observed in railway transportation. Consequently, over the course of five years, the proportion of transit cargo among all railway cargo transported increased by 20,2%. The majority of cargo transported by sea is transit cargo.

North-West Transport Corridor

The establishment of the North-West transport corridor was made feasible by the inauguration of the Baku-Tbilisi-Kars railway in 2017. The North-West transport corridor has been designed for the implementation of increased cargo transportation, primarily between Turkey and Russia, through the Baku-Tbilisi-Kars railway. (Map 3) Furthermore, the North-West transport corridor facilitates the transportation of Russian-made coal and grain cargo to Turkey by the Baku-Tbilisi-Kars railway [10].

Route: Russia-Azerbaijan-Georgia-Turkey-Europe

Figure 6 – North-West Transport Corridor
Source: https://freight.ady.az/beynelxalq-dehlizler/simal-qerb-neqliyyat-dehlizi

As indicated by the data provided by the State Statistics Committee of the Republic of Azerbaijan, the volume of cargo transported through the North-West transport corridor during the period between January and March 2024 was 1.698,9 thousand tons.

South-West Transport Corridor

The decision to create the South-West transport corridor was taken at the beginning of 2016. The South-West transport corridor is designed to facilitate the movement of goods from India, primarily from the ports of Mumbai and Navi Mumbai, to Europe, with destinations including Rotterdam, the Baltic Sea, Northern Europe, and Russia. The route also allows for the return journey, passing through the territories of Iran, Azerbaijan, Georgia, and Ukraine (Map 4). The establishment of the South-West Corridor will facilitate the development of new opportunities for the transportation of goods, ensuring the implementation of a secure, expedient and consistent pricing structure.

The principal advantage of the South-West Corridor in comparison to alternative routes, particularly the maritime route via the Suez Canal, is the relatively short transit distance and the potential for significant time savings, up to approximately three times the original duration. Therefore, the estimated transit time for sea transportation from the Persian Gulf and India to Europe is approximately 35-37 days. It is anticipated that this period will be reduced to 10-12 days in the future via the South-West Corridor [10].

Route: India-Persian Gulf-Iran-Azerbaijan-Georgia-Turkey/Black Sea-Europe

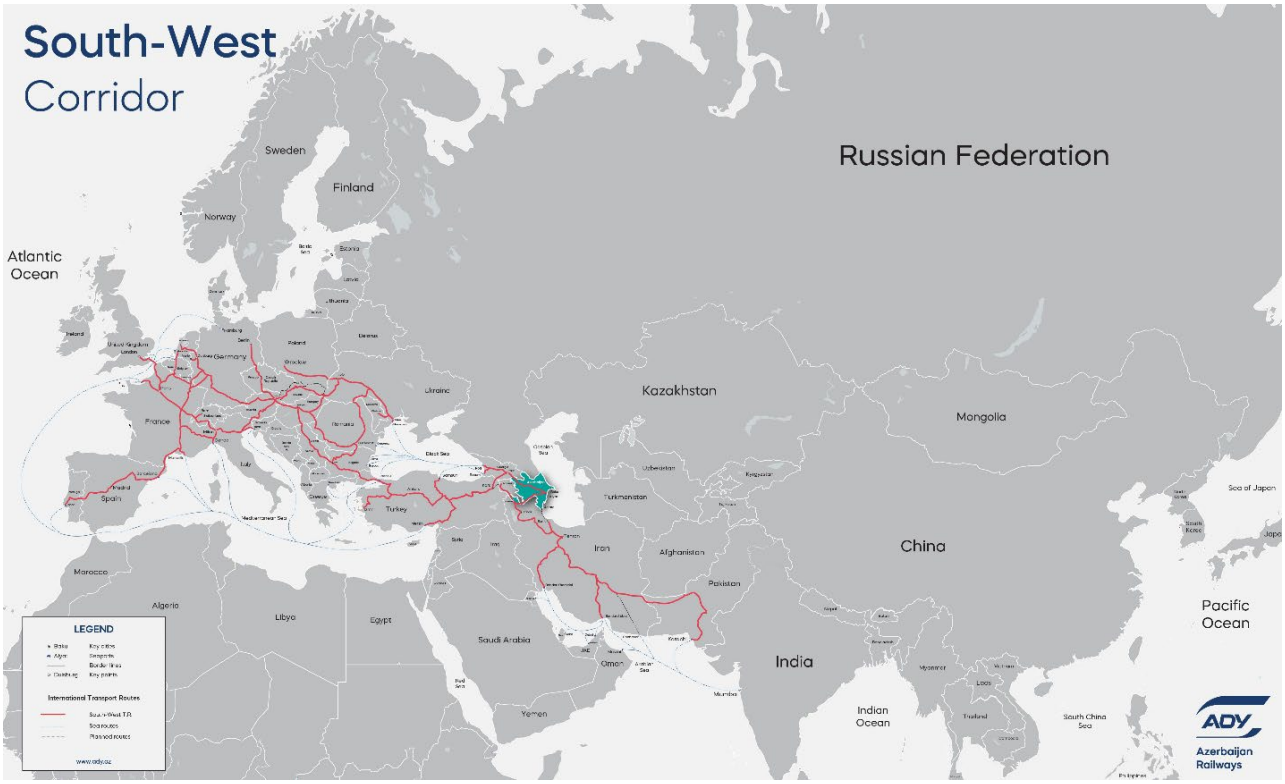


Figure 7 – South-West Transport Corridor
Source: https://freight.ady.az/beynelxalq-dehlizler/cenub-qerb-neqliyyat-dehlizi

It is worthy of note that during the initial three-month period of 2024, the volume of cargo transported via the South-West transport corridor reached 86,3 thousand tons. The completion of the North-South corridor, as well as the full utilisation of the potential of the South-West corridor, is contingent upon the construction of the Rasht-Astara and Qazvin-Rasht railway lines. The expeditious construction of these lines is of great consequence with respect to the attraction of Indian transported goods to the South-West Corridor, which will traverse Azerbaijan under more favourable conditions.

Cargo and passenger transportation potential of Azerbaijan transport system

In light of the prevailing political and economic circumstances on the global stage, the enhancement of Azerbaijan's regional standing has become increasingly evident. The progression of international transportation initiatives through the country's territory has consequently garnered heightened attention to the nation's transport system. In light of the aforementioned considerations, it is of paramount importance to undertake a comprehensive study and evaluation of the current cargo and passenger transportation potential of Azerbaijan.

Freight. In the year 2023, the volume of cargo transported in Azerbaijan exhibited a 5,3 percent increase relative to the preceding year. In the same year, economic entities operating in the transport sector were responsible for the transportation of 230,2 million tons of cargo. Cargo transportation by sea accounted for 3,9% of the total, while railways handled 7,9%. Air transportation was negligible at 0,1%, while road transport and pipelines accounted for 58,4% and 29,7% of the total, respectively (Fig 8).

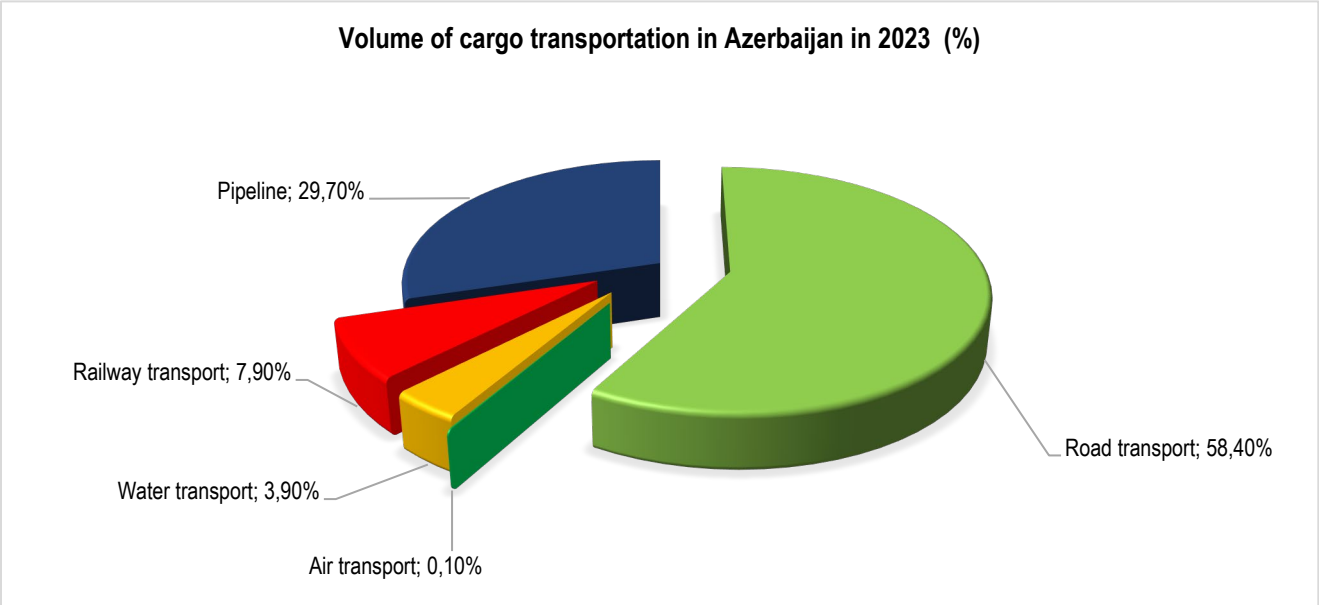


Figure 8 – Volume of cargo transportation by means of transport in 2023 (in %)
Source: Compiled by the authors based on the data of the State Statistics Committee of the Republic of Azerbaijan

In the year 2023, the volume of cargo transported by vehicles belonging to the non-state sector increased by 5,4 percent. Furthermore, the specific weight of this sector in the total volume of transported goods was 78,2 percent.

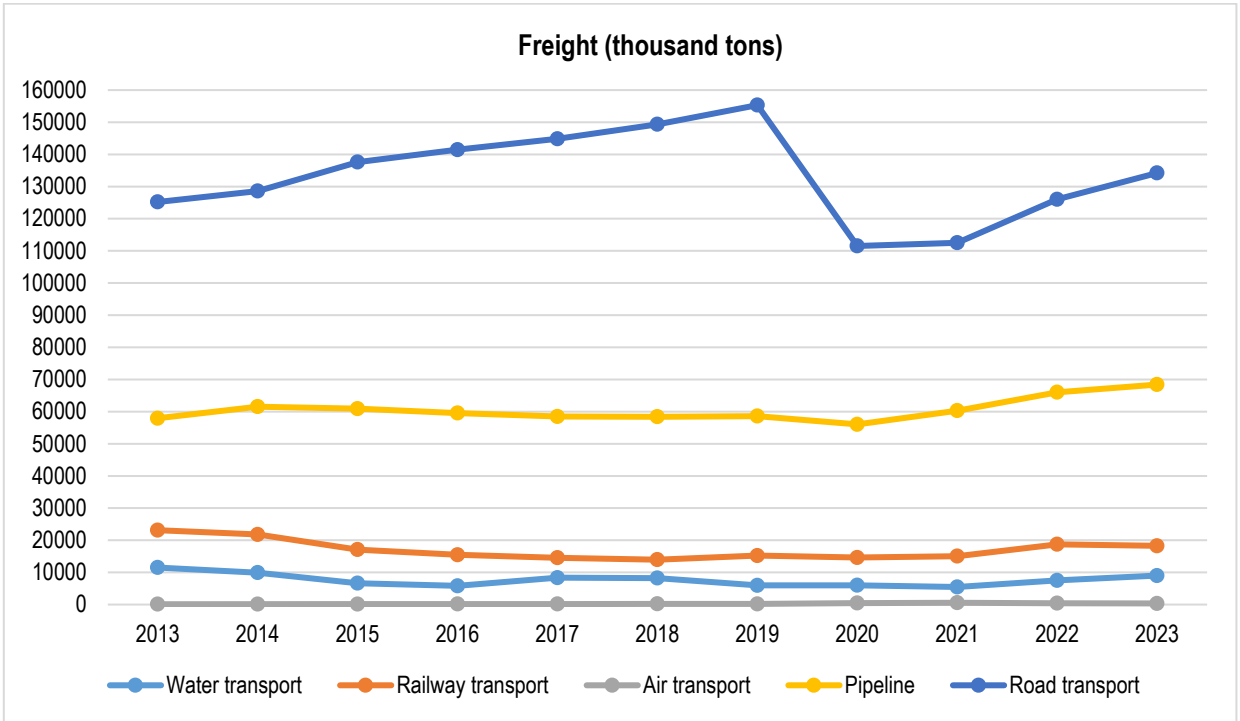


Figure 9 – The volume of cargo transported in the transport sector
Source: Compiled by the authors based on the data of the State Statistics Committee of the Republic of Azerbaijan

Figure 9 illustrates the volume of cargo transported by various modes of transportation in Azerbaijan between 2013 and 2023. As can be observed from the graph, there has been a notable increase in pipeline transportation in recent times. This may be particularly associated with the observed increase in gas exports. Consequently, 90,9% of exported goods in 2022 and 89,7% in 2023 were transported by pipeline. In 2023, 134,2 million tons of cargo were transported by road, representing the largest specific weight in the volume of transportation in the transport sector. This figure represents a 6,5% increase compared to the previous year. The greatest volume of transportation of this type was recorded in 2019. The volume of road freight declined by 28% in 2020 as a consequence of the restrictions imposed during the global pandemic. In the period following the pandemic, there has been a further increase. Despite the relatively minor role played by air transport in the context of global cargo transportation, with a market share of approximately 1%, there has been a notable increase in the volume of cargo transported by this mode of transportation over the past decade, with a growth rate exceeding twofold. A reduction in the volume of railway transportation is evident. Consequently, in 2023, 18,3 million tons of cargo were transported, representing a 2,6% decline compared to the preceding year. During this period, the greatest volume of cargo was transported by sea in 2013. Despite the intermittent decline in maritime freight volumes, a recent upward trend has been discernible. In 2023, the volume of cargo transported by sea reached 9.010,8 thousand tons, representing a 19,8% increase compared to the previous year. The principal factor contributing to this is the growth in the volume of cargo transported via the Middle Corridor. It is noteworthy that 54,4% of the cargo transported by this mode of transportation was oil and oil products.

Passenger transport. In the year 2023, there was an 18,7% increase in the number of passengers transported in comparison to the preceding year. In the same year, the total number of passengers transported by the various transport enterprises was 1.923,6 million. The majority of passengers (88,1%) were transported by road, while 11,4% were conveyed by metropolitan (subway), with the remainder utilising alternative modes of transport. Furthermore, the statistical data indicates that the majority of passenger transportation in Azerbaijan is conducted via road and metropolitan transportation.

The construction of a metropolitan railway system is typically undertaken in urban areas with a population of over one million. In the country of Azerbaijan, the metropolitan is currently only operational in the capital city of Baku. It is the inaugural metropolitan system in Turkey and the Islamic countries of the Middle East [14].

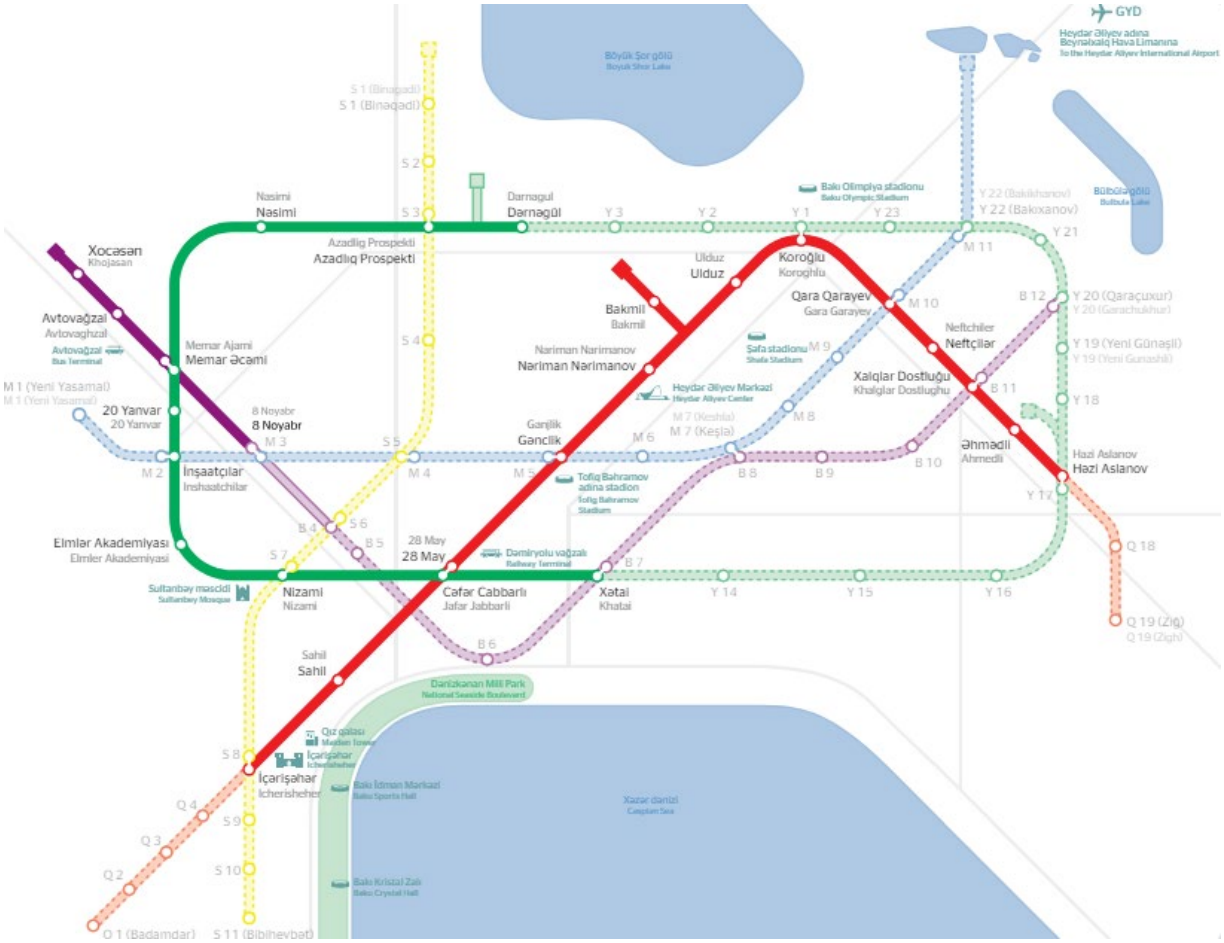


Figure 10 – Conceptual development scheme of Baku metropolitan (subway) lines
Source: https://metro.gov.az/az/page/xetlerimiz/konseptual-sxem

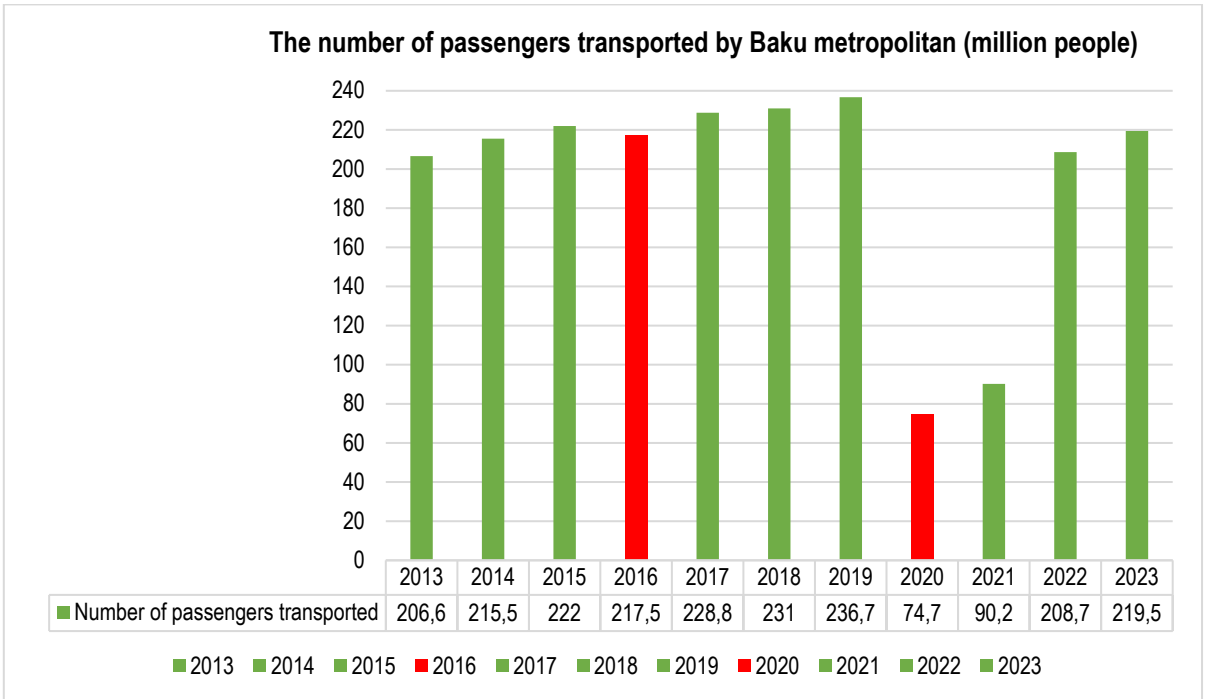
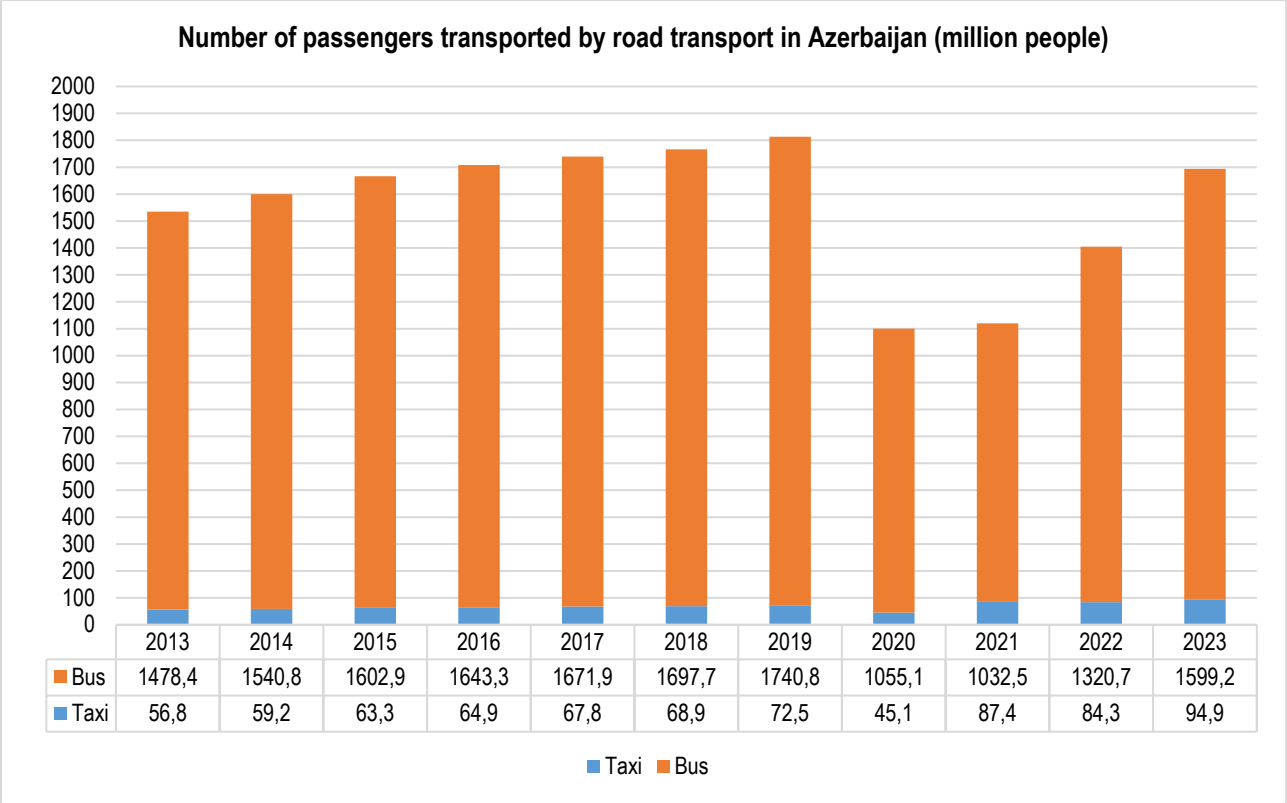


Figure 11 – Number of passengers transported by Baku metropolitan (million people)
Source: Compiled by the authors based on the data of the State Statistics Committee of the Republic of Azerbaijan

Figure 11 illustrates the total number of passengers transported by the Baku metropolitan system over the period 2013-2023. Over the course of the observed period, the total number of passengers transported by metropolitan has increased by 6,2%. The data presented in the graph clearly indicates that the highest number of passengers were transported in 2019 (236,7 million), while the lowest number of passengers were transported in 2020 (74,4 million).

The majority of passenger transportation by road is by bus and taxi. In 2023, 94,4% of passengers utilized the services of buses, while 5,6% utilized the services of passenger taxis.



	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Bus	1478,4	1540,8	1602,9	1643,3	1671,9	1697,7	1740,8	1055,1	1032,5	1320,7	1599,2
Taxi	56,8	59,2	63,3	64,9	67,8	68,9	72,5	45,1	87,4	84,3	94,9

Figure 12 – The number of passengers transported by road transport in Azerbaijan (million people)

Source: Compiled by the authors based on the data of the State Statistics Committee of the Republic of Azerbaijan

Figure 12 illustrates the total number of passengers transported by road in Azerbaijan from 2013 to 2023. From 2013 to 2023, the number of passengers transported by bus exhibited an 8,2% increase. The number of passengers transported by taxi increased by 67,1%. The greatest number of passengers were transported by road in 2019 (1.813,3 million in total), while the lowest number were transported in 2020 (1.100,2 million in total). In 2019, the greatest number of passengers were transported by bus (1.740,8 million), while in 2023, the greatest number were transported by taxi (94,9 million). From the seventh point on the graph, it is evident that the bus is the most utilised form of public transportation for both intra-city and inter-city travel in Azerbaijan. There has been a notable surge in interest in taxis since 2020, which coincides with the period of the pandemic.

As illustrated in Graphs 6 and 7, the volume of passenger transportation in Azerbaijan has yet to reach the level recorded in 2019 during the post-pandemic period. One of the factors contributing to the decline in public transportation usage is the preference of a portion of the population for

private vehicles. This situation is a consequence of the limitations imposed on public transportation, particularly during the pandemic. According to data from the State Statistics Committee of the Republic of Azerbaijan, the number of private passenger cars imported into the country in 2021 increased by 72,4%, reaching 76.348 units. In total, 264.087 private passenger cars were imported into Azerbaijan from abroad between 2020 and 2023.

Additionally, railway, air and sea transport are utilised for the transportation of passengers over relatively long distances. Although the contribution of these modes of transport to passenger transportation is relatively minor, their role is nevertheless significant.

Table 2 – Passenger transportation in the transport sector of Azerbaijan (thousand people)

Passenger transportation in the transport sector of Azerbaijan (thousand people)											
	2013	***2014***	***2015***	***2016***	***2017***	***2018***	***2019***	***2020***	***2021***	***2022***	***2023***
Railway transport	2508	2517	1883	1978	2490	2841	3850	2124	2826	5137	7108
Water transport	14	15	9	20	17	16	22	20	18	21	24
Air transport	1664	1788	1818	1980	2359	2399	2704	578	1133	2254	2912

Source: Compiled by the authors based on the data of the State Statistics Committee of the Republic of Azerbaijan

Table 2 presents the data on the number of passengers transported by sea, air, and rail. As per the schedule, the number of passengers transported by railway has been observed in recent times. Consequently, in 2023, there was an increase of 38,4% in the number of passengers transported. As reported by Azerbaijan Railways CJSC, international passenger transportation via this mode of transport has been suspended since the second quarter of 2020. Nevertheless, there was an increase of approximately 26,5% in the number of passengers transported to suburban and domestic destinations. Despite the lower demand for sea transport compared to other modes of transportation, the volume of passenger transportation via this mode increased by 10,7% in 2023. For passengers undertaking long-distance travel, air transport is the preferred mode of transportation. In the period following the pandemic, the volume of passenger transportation by this mode of transport also increased. Consequently, in 2023, 2.911,8 thousand passengers, representing a 29,2% increase over the previous year, were transported by air. The overwhelming majority of this transportation, 99,9%, was carried out by state-owned aircraft, while the remaining 0,1% was facilitated by private enterprise.

Profitability of Azerbaijan transport system. In examining the transport system of the Republic of Azerbaijan, it is essential to assess the efficiency with which it operates. It is established that the revenue streams for the various modes of transport are derived from service fees paid by passengers or shippers. Chart 8 illustrates the revenue generated from transportation in the Azerbaijani transport sector between 2013 and 2022.

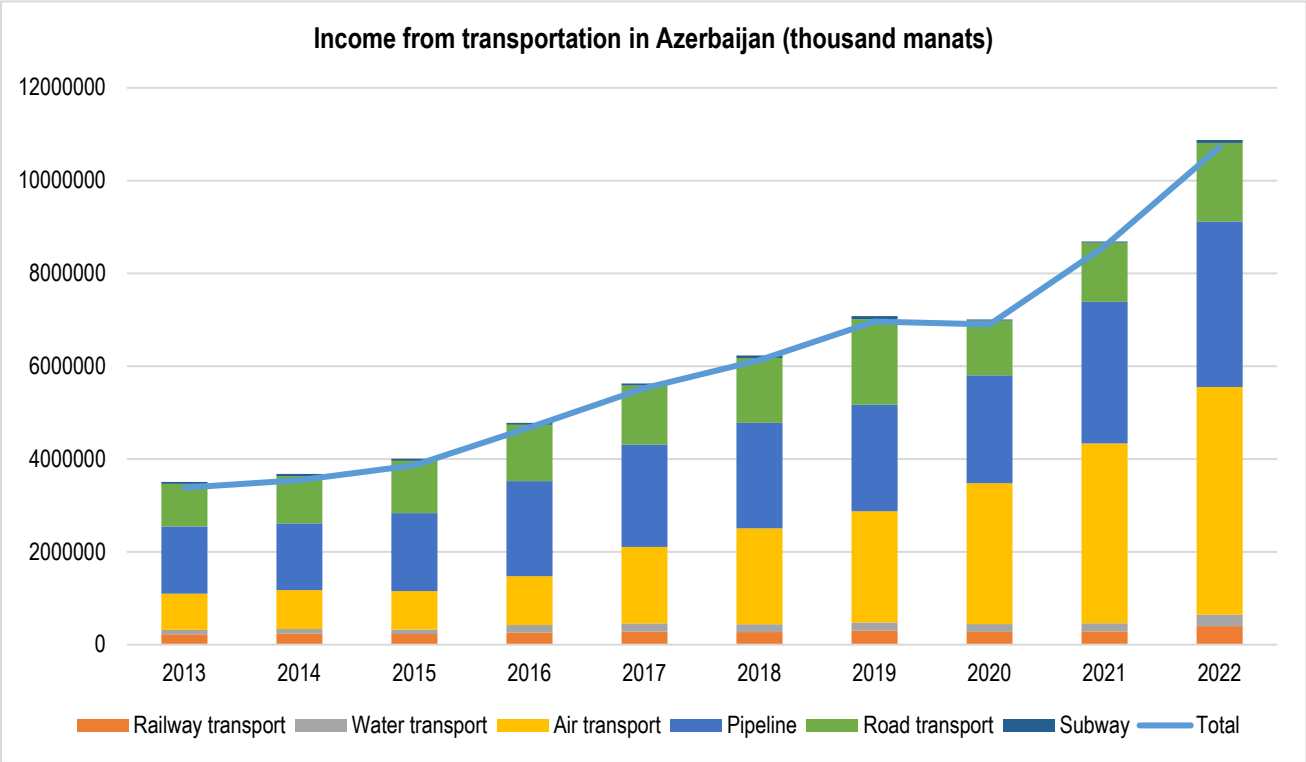


Figure 13 – Income from transportation in the transport sector of Azerbaijan
Source: Compiled by the authors based on the data of the State Statistics Committee of the Republic of Azerbaijan

As illustrated in Chart 8, revenues from transportation have demonstrated growth over time, with the exception of 2020. The most substantial increase was observed in 2022. Consequently, the income generated in the current year increased by 25,1% in comparison to the preceding year, reaching a total of 10.873.130 thousand manats. During this period, a notable increase was observed, particularly in the areas of air and pipeline transport. The revenue generated from air transport, which is the most expensive form of transportation, has increased by a factor of six or more over the course of nine years. As indicated by the data provided by the State Statistics Committee, 74,3% of the revenues generated by this mode of transportation were derived from the transportation of cargo, while 25,7% were derived from the transportation of passengers. In light of the pivotal role of the oil and gas sector in the Azerbaijani economy, it is evident that the revenues generated by pipeline transport hold a considerable specific weight. Over the past period, there has been a 40,6% increase in revenues derived from pipeline operations. By 2019, the income generated from the transportation of goods to Azerbaijan via oil pipelines was greater, but in recent times, the income from the transportation of goods via gas pipelines has exceeded that from oil pipelines. Consequently, 34,7% of the revenues generated from pipeline transportation in 2022 were derived from oil pipelines, while 65,3% were derived from gas pipelines. The highest revenue for road transport was recorded in 2019. In 2020, the decline in revenue resulting from the reduction in demand for transportation services during the pandemic also contributed to this overall decrease. However, the overall revenues for road transport exhibited a 45,9% increase during the analysed period. In 2022, the revenues for rail and maritime transport demonstrated a 40,1% and 39,3% growth, respectively, in comparison to the previous year. Among the revenues obtained from transportation, the

metropolitan has the least specific weight. Despite an increase in demand for the metropolitan in the post-pandemic period, the income generated for this mode of transport is insufficient to cover the costs incurred.

The primary expenditure categories within the transportation sector are energy costs and labour expenses. At the present time, research is being conducted with the specific objective of reducing these costs. Graph 9 illustrates the financial outlay associated with the transportation of goods and people in Azerbaijan between 2013 and 2022.

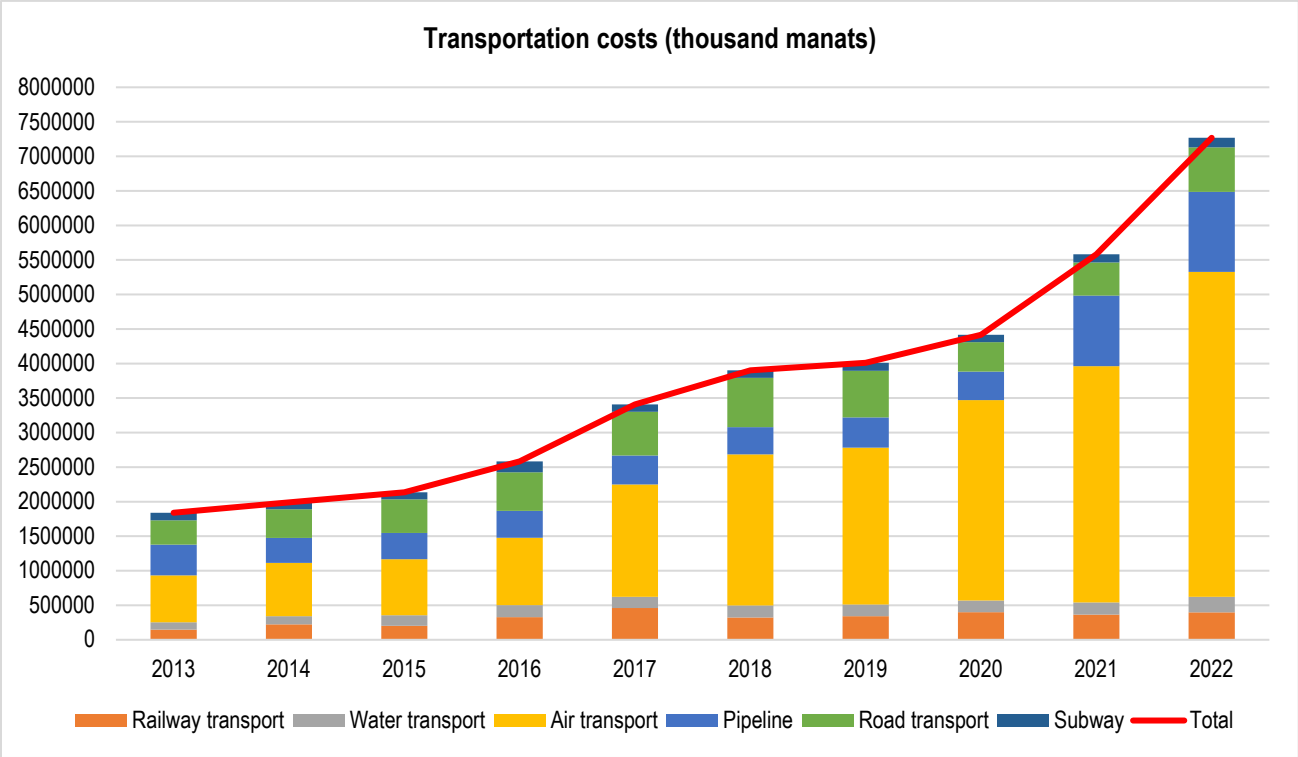


Figure 14 – Costs incurred for transportation in the transport sector in Azerbaijan
Source: Compiled by the authors based on the data of the State Statistics Committee of the Republic of Azerbaijan

As evidenced by Chart 9, the transportation sector has witnessed a gradual escalation in costs over the course of the 2013 to 2022 period. The most substantial increase was observed in 2022. Consequently, the financial outlay on transportation in 2022 was 30% greater than that of the preceding year. During the period under review, there was a notable rise in expenditure on air transport. Similarly, there has been a marked increase in costs, with a more than sixfold increase observed over the period in question. The majority of the costs, amounting to 70,6% of the total, were incurred in the context of cargo transportation, while the remaining 29,4% were attributed to passenger transportation. It is evident that the financial outlay associated with pipeline transportation has risen in the period subsequent to 2020. Consequently, in 2021, the costs associated with this mode of transportation increased by a factor of two or more. In 2022, there was a 13,4% increase in comparison to the preceding year. The highest costs associated with road transport were incurred in 2018. In the subsequent year, costs exhibited a 5,5% decline. Given the observed increase in both revenue and transportation volume in 2019, it can be posited that road transport operated in an efficient manner during that period. During this period, the greatest expenditure was

incurred on railway transport in 2017. The financial outlay associated with the transportation of this particular commodity exhibited an increase of 9,3% in 2022. A recent increase has been observed in the costs associated with maritime and metropolitan transportation. Consequently, the costs of transportation by sea and metropolitan transport increased by 26,4% and 19%, respectively, in 2022.

It is possible to ascertain the profitability of different modes of transport by calculating the income generated from transportation in Azerbaijan and comparing it to the costs incurred for these transportation services.

Table 3 – Profit (loss) indicators in transportation by means of transport in Azerbaijan

Profit (loss) indicators for transportation by means of transport in Azerbaijan (thousand manats)						
	Railway transport	Water transport	Air transport	Pipeline	Road transport	Subway
2013	76860	(9595)	101173	1003330	565095	(67697)
2014	12552	(16690)	67599	1076697	604352	(56733)
2015	30101	(60827)	17636	1300041	643051	(60840)
2016	(64966)	(13864)	78914	1656331	656992	(115766)
2017	(181148)	17331	20843	1784999	639385	(60678)
2018	(52586)	(4110)	(120914)	1879106	682729	(54814)
2019	(40924)	10851	124140	1855181	1169422	(46683)
2020	(124214)	191	132368	1911911	755525	(84845)
2021	(79320)	1653	453323	2028293	794595	(90916)
2022	1026	25084	200021	2408749	1048295	(78582)

Source: Compiled by the authors based on the data of the State Statistics Committee of the Republic of Azerbaijan

Table 3 illustrates the profitability of transportation by various modes of transport over the period 2013-2022. As evidenced by the data presented in the table, in 2022, profits were generated from the transportation of goods and passengers by other types of transport, with the exception of the metropolitan system. The Tariff Council's determination of metropolitan transport prices is the primary cause of the damage. Nevertheless, the Baku metro persists in its operations due to the inherent characteristics of a natural monopoly [15]. Despite the decline in profitability observed in the road transport sector during the 2020-2021 period, largely attributable to the pandemic, this mode of transportation continues to demonstrate overall viability. Furthermore, the fact that carriers are private enterprises engaged in this type of transport also has an impact on this issue. The profitability of pipeline transportation has been a consistent feature throughout the period under review. During the period under investigation, aircraft carriers incurred losses in 2019. In accordance with the financial statements of AZAL CJSC, the national air carrier concluded the 2022 fiscal year with a net profit of 110.620 thousand manats. The reduction in the quantity of freight transported by rail, in comparison to previous periods, coupled with the cessation of passenger services to international destinations, has resulted in a decline in the profitability of this sector. In 2022, the profit on transportation increased by more than 15 times in the case of sea transport, which is distinguished by a low cost of transportation.

Conclusions. A review of the transport system in Azerbaijan reveals that the sector's contribution to the country's gross domestic product (GDP) has grown in recent years.

Concurrently, the level of financial resources allocated to the transport sector from the state budget has also increased. The allocated funds are being utilized for the implementation of extensive construction projects aimed at enhancing the country's transport infrastructure. The implementation of measures in territories liberated from occupation in recent years serves as evidence of this. A review of investment in the transport sector reveals that the majority of funds are allocated to infrastructure projects. It is important to note that in order to achieve comprehensive development of the transport system, the fleet of vehicles must also be renewed. As indicated by the data provided by the State Statistics Committee of the Republic of Azerbaijan in 2022, 62,9% of the bus fleet for road transport and 56,6% of trucks are comprised of vehicles that are 20 years of age or older. This situation has the dual effect of reducing the efficiency of transportation and causing further environmental damage. It is therefore evident that, in addition to infrastructure, attention should be paid to the renewal of existing fleets for transport types. In this regard, measures have already been implemented. It is anticipated that 160 electric buses imported from this country will be introduced to the fleet as part of the China-Azerbaijan cooperation initiative. Additionally, the construction of a manufacturing facility in the Sumgait Chemical Industrial Park is projected to yield 150-200 electric buses annually. The information indicates that the manufactured electric buses will not only satisfy the domestic demand but also enhance Azerbaijan's export potential. [16].

A review of the routes traversed by the international corridors linking Europe and Asia reveals the pivotal role played by Azerbaijan in the context of transit transportation. The transportation of goods through the territory of Azerbaijan has the dual benefit of reducing both the costs associated with the shipment of goods and the time spent on these shipments. Nevertheless, the unfulfilled potential of the Rasht-Astara and Qazvin-Rasht railway projects precludes the possibility of utilizing the full capacity of the aforementioned corridors. Conversely, efforts are underway to inaugurate the Zangezur transport corridor, which will constitute a component of the East-West corridor uniting Asia and Europe. The inauguration of the Zangezur corridor, which holds strategic, political, and moral value, will foster new economic prospects for Azerbaijan and the broader region. It is anticipated that the Zangezur corridor will enhance the transportation capacity of the Middle Corridor, increasing it to 8-10 million tons per year.

In addition to the aforementioned improvements to the corridors, measures are being implemented with the objective of enhancing the infrastructure and increasing the appropriate transmission capacity, with the ultimate goal of increasing the volume of cargo transportation. The work carried out at the Baku International Sea Trade Port, which serves as the primary transport and logistics hub for the region in Eurasia and is situated in an area where the main railways and highways of Azerbaijan converge, is conducive to this objective. The initial phase of the Baku Port construction project was completed in 2018. The port's current cargo transportation capacity is 15 million tons of cargo and a container equivalent to 100.000 TEU. A second phase of construction is also being planned for the port, with the objective of increasing the annual cargo transportation capacity to 25 million tons and 500.000 TEU containers. A project has been devised for the construction of a TIR park in the port area, which will facilitate the future development of the port [17].

The findings of the conducted research indicate that urban transportation plays a more significant role in the transportation of passengers. In order to enhance the efficiency and sustainability of urban transportation, the Master Plan of Baku City and the conceptual development scheme of Baku Metro lines have been devised. The Baku City Master Plan delineates the projected developments to be

undertaken by the year 2040. The plan encompasses the development of the metropolitan transport network, the railway network, the enhancement of the street-road network, and the establishment of bicycle paths and transit hubs. The plan outlines the reconstruction, activation or construction of 20 passenger stations on the Absheron peninsula by the end of 2027. Furthermore, the construction of a new railway line to Heydar Aliyev International Airport is also planned. By 2040, the total length of the railway network on the Absheron Peninsula is projected to increase from 195,4 km to 338,6 km, while the number of stations is expected to grow from 26 to 54. New transport exchange centres are being constructed in various locations throughout the city with the objective of facilitating the convenient movement of passengers. In addition to enhancing the comfort and security of passengers and the operational efficiency of bus transportation, these interchanges are also instrumental in mitigating congestion and reducing traffic congestion [18].

In accordance with the General Plan, the metropolitan transport system will continue to occupy a dominant position within the public transport system of Baku city, providing the primary public transport connection between the most densely populated areas of the agglomeration and the central areas. At the present time, in accordance with the prospective development plan, the construction of tunnels, stations and depots for new lines is underway, as is the step-by-step reconstruction of existing stations and the equipping of these with modern equipment. In addition, the construction of second exits for deep-based single-exit stations is also being carried out. In accordance with the Baku Metro Lines Conceptual Development Scheme, the future network of the metropolitan will comprise five lines, 76 stations, six electric depots and 119,1 km of metropolitan lines, comprising three existing lines (Red, Green and Purple) and two additional new lines (Blue and Yellow). It is intended that 51 new subway stations and an 84,3 km metro line (Scheme 1) will be constructed.

A review of the transport system in Azerbaijan reveals that the revenues generated from transportation have consistently exceeded the costs incurred for these shipments over an extended period. The majority of the total revenues obtained in this sector, amounting to approximately 79,4%, were derived from freight, while the remaining 20,6% were generated from passenger transportation. The majority of costs were incurred for the transportation of cargo (71,4%), while the remaining costs were incurred for the transportation of passengers (28,6%). The results of the conducted research indicate that, while the profitability indicator for individual types of transport differs significantly, the overall efficiency of the transport system, particularly in the context of cargo transportation, can be deemed satisfactory.

The research findings indicated a notable increase in the volume of cargo transported by non-state enterprises and the number of passengers. The principal reason for this is that the majority of road transport carriers are private enterprises. Furthermore, the rapidly developing air transport sector has recently seen the emergence of private airlines specializing in cargo transportation. Nevertheless, state-owned enterprises maintain a dominant position in the rail, sea and air passenger transportation sectors.

It is also noteworthy that all infrastructure facilities for all types of transport in Azerbaijan are fully owned by the state. Given the considerable costs associated with the construction and restoration of transport infrastructure, it is crucial to foster greater private sector involvement in this field. In order to achieve this, the use of public-private partnerships (PPP) represents an effective method, as evidenced by global experience. Furthermore, Azerbaijan is well-positioned to leverage this experience. Consequently, in 2022, the "Law of the Republic of Azerbaijan on public-private partnership" was enacted,

thereby establishing a legal framework for such arrangements. Subsequently, concerted efforts are being made to attract both local and foreign investors.

The article is a continuation of a series of publications by the authors on issues of increasing economic efficiency and strategic management of transport [19 – 21].

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INNOVATIVE INFORMATION PROCESSES IN THE AVIATION INDUSTRY

Ganna Gurina, Podrieza Serhii «Innovative information processes in the aviation industry» *Innovative information and other numerous developments resulting from the application process of digitalization constitute a comprehensive structure that is important for any industry, and for the aviation industry in particular. This special relevance stems primarily from the defining characteristic of the aviation industry - the ability to rapidly develop, and is also supported by such important management components as the cost structure, safety and intensity of competition, which play an equally important role both for the domestic aviation industry and for global aviation giants. In the era of large-scale digitalization, the aviation IT industry is facing a number of challenges related to the combination of new distribution channels, social networks, Big data, cloud technologies, etc. One of the main challenges of the time is the need to solve the security problem when software components are distributed and operated in hybrid clouds, the providers of which may be independent from each other. The difficulty lies not only in defining and expressing the desired level of security in software, but also in how cloud services affect security assurances in the aviation industry. However, effective digitalization does not begin with the introduction of the latest technologies, but with the transformation of organizations in order to use the potential of digital solutions.*

Keywords*:* Innovation, information, digitalization, digital tools, management, enterprise, aviation industry, implementation of the latest technologies, efficiency, improvement of management, ensuring the activities of enterprises

Ганна Гуріна, Сергій Подрєза «Інноваційні інформаційні процеси в авіаційній галузі» *Інноваційна інформація та численні інші розробки, що є результатом процесу цифровізації, становлять важливу структуру для будь-якої галузі, а для авіаційної промисловості - особливо. Ця особлива актуальність випливає насамперед із визначальної характеристики авіаційної галузі - здатності швидко розвиватися, а також підтримується такими важливими складовими*

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управління, як структура витрат, безпека та інтенсивність конкуренції, які відіграють однаково важливу роль як для внутрішньої авіаційної галузі, так і для глобальних авіаційних гігантів. У епоху масштабної цифровізації авіаційна IT-галузь стикається з низкою викликів, пов'язаних із поєднанням нових каналів розповсюдження, соціальних мереж, великих даних, хмарних технологій тощо. Одним із головних викликів сьогодення є необхідність вирішення проблеми безпеки, коли програмні компоненти розподілені та працюють у гібридних хмарах, постачальники яких можуть бути незалежними один від одного. Складність полягає не лише у визначенні та вираженні бажаного рівня безпеки у програмному забезпеченні, але й у тому, як хмарні сервіси впливають на забезпечення безпеки в авіаційній галузі. Однак ефективна цифровізація не починається із запровадження новітніх технологій, а з трансформації організацій для використання потенціалу цифрових рішень.

Ключові слова: інновації, інформація, цифровізація, цифрові інструменти, управління, підприємство, авіаційна галузь, впровадження новітніх технологій, ефективність, вдосконалення управління, забезпечення діяльності підприємств..

Introduction. This approach involves the development of new business models for aviation enterprises, changing the boundaries of activity with the help of digital technologies and rethinking the entire management system of the airline. In addition, for the implementation of the digitalization process, an important aspect is the education and training of personnel. It is imperative that every employee understands the goals and benefits of digitization while simultaneously creating an appropriate organizational culture. Therefore, it is necessary to provide for the acquisition of certain knowledge and skills necessary for the improvement of this process and the provision of new interdisciplinary qualifications.

Digitalization is transforming industries across the globe, and the aviation sector is no exception. The integration of digital technologies into aviation operations has significantly enhanced the competitiveness of aviation enterprises, enabling them to streamline operations, improve customer service, and reduce costs. This text explores the positive impact of digitalization on the competitiveness of aviation enterprises worldwide.

Digitalization enables aviation enterprises to harness real-time data through Internet of Things (IoT) devices and sensors embedded in aircraft. This data can be used to monitor the health of aircraft systems continuously and perform predictive maintenance. By identifying potential issues before they become critical, airlines can minimize downtime, avoid costly repairs, and ensure the safety and reliability of their fleets. This proactive approach to maintenance not only enhances operational efficiency but also reduces operational costs.

Literature and researches review. A significant contribution to the formation of the basic provisions and concepts of the use of the latest technologies in the aviation industry belongs to both domestic and foreign scientists, who in turn implemented approaches to the use of digitalization tools in the competitive environment of aviation enterprises. Digital technologies, such as advanced analytics and artificial intelligence (AI), are used to optimize flight operations [4-7]. For instance, AI can analyze weather patterns, air traffic, and other variables to recommend the most efficient flight paths [8-12]. This optimization leads to reduced fuel consumption, lower emissions, and shorter flight times, all of which contribute to cost savings and improved environmental performance [1-3]. Additionally, digitalization allows for more precise scheduling and resource allocation, further enhancing operational efficiency [13-16].

Results, analysis and discussion. Digitalization allows aviation enterprises to offer personalized services to their customers. By analyzing big data, airlines can understand

passenger preferences and behaviors, enabling them to tailor services and offers to individual needs. This personalized approach can include customized in-flight entertainment, targeted promotions, and personalized communication. Enhancing the passenger experience helps airlines build loyalty and attract repeat customers, thereby improving their competitive edge.

Digitalization simplifies the check-in and boarding processes, reducing wait times and enhancing convenience for passengers. Mobile check-in, biometric verification, and automated boarding gates are examples of digital innovations that speed up these processes. By providing a smoother and more efficient airport experience, airlines can improve customer satisfaction and differentiate themselves from competitors [1, 7, 8].

Automation, powered by digital technologies, helps aviation enterprises reduce operational costs. Automated systems can handle various tasks, from customer service chatbots to baggage handling and flight scheduling. By reducing the reliance on manual labor, airlines can lower labor costs and increase productivity [2, 9, 18]. Moreover, automation minimizes human error, leading to more reliable operations.

Digitalization opens up new revenue streams for aviation enterprises. For example, airlines can monetize data insights by offering targeted advertising and personalized travel packages. Additionally, digital platforms enable ancillary revenue opportunities, such as selling seat upgrades, extra baggage, and travel insurance [3,5, 10]. By leveraging digital channels, airlines can enhance their revenue generation capabilities and improve profitability.

The adoption of digital technologies fosters a culture of innovation within aviation enterprises. Companies that embrace digitalization are more agile and better equipped to respond to market changes and emerging trends. This adaptability allows them to stay ahead of competitors and capture new market opportunities. Furthermore, digitalization facilitates collaboration with technology partners and startups, driving continuous innovation and keeping airlines at the forefront of industry developments.

Digital platforms enable aviation enterprises to expand their global reach and connectivity. Online booking systems, mobile apps, and social media channels allow airlines to engage with customers worldwide and provide seamless travel experiences. This global connectivity enhances brand visibility and helps airlines tap into international markets, thereby increasing their competitive advantage on a global scale.

Digitalization has a profound positive impact on the competitiveness of aviation enterprises worldwide. By enhancing operational efficiency, improving customer experience, reducing costs, and enabling new revenue streams, digital technologies empower airlines to achieve a competitive edge in a highly dynamic industry. Embracing digital transformation is essential for aviation enterprises to thrive in the digital age and maintain their position as industry leaders.

The aviation industry plays a critically important role in the global economy by providing fast and safe transportation of passengers and cargo. However, as the scale of operations expands, this industry faces new challenges such as the need to enhance efficiency, safety, environmental sustainability, and passenger comfort [4, 13]. Innovative information technologies (IT) play a key role in addressing these challenges by optimizing processes and improving service quality.

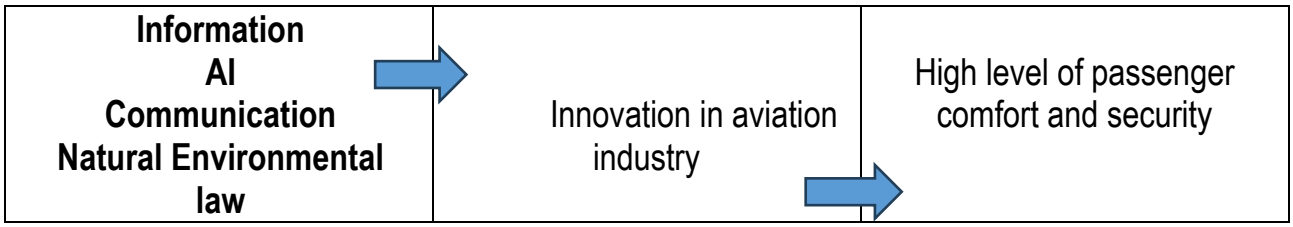

Figure 1 – Components of the system of innovative solutions in the aviation industry in a competitive environment
Source: summarized by the author for [11, 14, 17]

Air travel is in a period of great change. With the rapid pace of innovation, airlines and airplane makers are working hard to keep up. For the most part, the airlines and the companies that make their planes are not all that well equipped to react quickly to change. A new plane takes more than a decade to put into service and its designed to keep flying for several subsequent decades. Usually, a major industry-wide overhaul to passenger experience happens once every decade or two. We are currently in such a generational shift. Innovations such as new composite-bodied airliners liked the Boeing 787 and the Airbus A350, as well as technologies like satellite-based internet and geared turbofan engines, come to mind. But that doesn't mean the industry is fresh out of cool stuff. In fact, the pace of development and innovation is only quickening in its pace. Like the automotive industry, airplane makers and the people who fly their planes understand the need to unpeg the development of aircraft hardware and software [6,18].

An industry once bound by the limits of flying metal is heading towards a future where software is growing in importance. Currently, the industry is working on many potentially game-changing innovations that could find their way into common airline use over the next couple of decades.

It is no secret that the automotive and healthcare industries have raced ahead in the digital sweepstakes, trailed by the airline industry, which has faltered, rather than flown, off the blocks. A sense of urgency now pervades the latter. According to recent research by Frost & Sullivan, digital transformation programs in the airline industry could generate an incremental value of $5-$10 for every passenger, annually [6, 12, 16]. Such extraordinary value generation would derive mainly from improved productivity, cost savings, and new ancillary revenue streams.

Airlines, of course, realize this. Digitization is already fostering innovative business models, while rapidly transforming core and non-core functions. Meanwhile, partnerships with technology solutions providers are driving overall corporate strategies—essentially, the vision of being among the most preferred airlines, improving customer satisfaction, and supporting sustainable profits.

Modern Information Technologies in the Aviation Industry:

The Internet of Things (IoT) is one of the key technologies transforming the aviation industry. Through IoT, aviation companies can collect and analyze vast amounts of real-time data. For instance, sensors onboard aircraft can monitor engine conditions, fuel consumption, weather conditions, and other parameters, enabling timely detection of potential issues and preventive maintenance.

Big data and analytics are another important direction in innovative information processes. Using big data, airlines can analyze passenger behavior, preferences, booking history, and other factors to improve service

quality. Additionally, big data analytics helps optimize flight routes, reduce fuel costs, and enhance fleet management efficiency.

Artificial intelligence (AI) and machine learning (ML) are used to automate many processes in the aviation industry. For example, AI-based systems can analyze data from various sources to predict flight delays, manage schedules, and optimize resources. Furthermore, AI can enhance safety by detecting suspicious activities or objects at airports.

Blockchain technology holds great potential for increasing transparency and security in the aviation industry. It can be used to track the origin and movement of aviation parts, ensure the security of transactions, and facilitate data exchange between different participants in the aviation ecosystem.

Innovative information technologies significantly improve flight management. Using IoT, big data, and AI allows real-time monitoring of aircraft conditions, weather forecasting, and route optimization. This helps reduce fuel costs, enhance flight safety, and minimize environmental impact.

Innovative technologies are also used to improve passenger service. Using big data and AI allows for personalized service, offering passengers individualized deals and discounts, and improving schedule management and passenger information. Additionally, automating processes such as check-in and security control reduces wait times and enhances passenger comfort.

Innovative information technologies play a crucial role in aircraft maintenance and repair. Using IoT and analytics enables timely detection and resolution of potential issues, reducing the risk of breakdowns and increasing flight safety. Furthermore, blockchain can be used to track the origin and movement of aviation parts, enhancing transparency and security of processes.

Conclusions. Although innovative information technologies have great potential for improving the aviation industry's operations, several challenges need to be addressed. These include high implementation costs, the need for highly skilled professionals, and data security and privacy concerns.

Despite the challenges, the prospects for using innovative information technologies in the aviation industry are very promising. Further development of IoT, big data, AI, and blockchain will allow for even greater improvements in efficiency, safety, and comfort in aviation. Additionally, new technologies such as quantum computing and 5G open new opportunities for innovation in this field.

Innovative information processes play a key role in the development of the aviation indusry. The use of advanced technologies such as IoT, big data, AI, and blockchain enhances efficiency, safety, and comfort while reducing environmental impact. Despite existing challenges, the prospects for implementing innovative information technologies in aviation are very promising, opening new opportunities for the industry's further development.

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PECULIARITIES AND WAYS OF RESOLVING THE MILITARY-POLITICAL CONFLICT

Nadiia Reznik. «Peculiarities and ways of resolving the military-political conflict». *The purpose of the article is to analyse the causes of the war that spread across the entire territory of Ukraine in February 2022. The main purpose of the study is to substantiate the essence of international economic and political conflicts, as well as scientific and theoretical approaches to resolving the political conflict that is the root cause of the russian-Ukrainian war.*

Various methods were used in the research, including the comparative-historical method, the method of source analysis, as well as induction, deduction, synthesis and analysis. This made it possible to gain a deeper understanding of the essence of political and political-economic conflict, as well as to divide political-economic conflicts into conflicts of values, interests, and identification, determining their essential causes.

An armed conflict that turns into a war is the most dangerous form of political conflict, as it causes a transition to destructive actions on the territory of the country, involves the involvement of a large number of participants and significant losses among the military and the civilian population. The historical and modern reality in Ukraine since 2014 is characterized by the presence of political and armed conflicts that arose as a result of serious contradictions that were not resolved within the framework of the post-Soviet system. It is because of this that armed, political, economic and inter-ethnic conflicts became more frequent in the 21st century.

For a long time, domestic science believed that state power and politics were aimed at finding a balance of the interests of seizing natural, energy and human resources, which was supposed to completely eliminate the conflict. However, the authorities of Ukraine did not cope with the invasion of certain territories, which has been going on for more than eight years. The article analyzes the prerequisites and nature of a full-scale invasion of the territory of Ukraine as a political conflict, and suggests key ways to resolve it.

The conclusion states that Ukraine's accession to the EU and NATO is a significant prospect for ensuring future guarantees of peace and protection against further or new invasion of the Russian Federation on our territory.

Keywords*:* political conflict, economic and political conflict,conflict management, russian-Ukrainian war

Надія Рєзнік. «Особливості та шляхи вирішення військово-політичного конфлікту». *Метою статті є аналіз причин війни, що у лютому 2022 року охопила всю територію України. Основною метою дослідження є обґрунтування сутності міжнародних економічних і політичних конфліктів, а також науково-теоретичних підходів до вирішення політичного конфлікту, який є першопричиною російсько-української війни.*

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У дослідженні використовувалися різні методи, зокрема порівняльно-історичний метод, метод джерелознавчого аналізу, а також індукції, дедукції, синтезу та аналізу. Це дозволило глибше зрозуміти сутність політичного та політико-економічного конфлікту, а також розділити політико-економічні конфлікти на конфлікти цінностей, інтересів та ідентифікації, визначивши їх сутнісні причини.

Збройний конфлікт, що переріс у війну, є найнебезпечнішою формою політичного конфлікту, оскільки зумовлює перехід до руйнівних дій на території країни, передбачає залучення великої кількості учасників і значні втрати серед військових та цивільного населення. Історична та сучасна реальність в Україні з 2014 року характеризується наявністю політичних та збройних конфліктів, які виникли внаслідок серйозних протиріч, що не були вирішені в рамках пострадянської системи. Саме через це у 21 столітті почастішали збройні, політичні, економічні та міжетнічні конфлікти.

Тривалий час вітчизняна наука вважала, що державна влада і політика спрямовані на пошук балансу інтересів захоплення природних, енергетичних і людських ресурсів, що мало б повністю усунути конфліктність. Однак влада України не впоралася із захопленням окремих територій, яке триває вже понад вісім років. У статті проаналізовано передумови та природу повномасштабного вторгнення на територію України як політичного конфлікту, а також запропоновано ключові шляхи його врегулювання.

У висновку зазначається, що вступ України до ЄС і НАТО є вагомою перспективою для забезпечення майбутніх гарантій миру та захисту від подальшого або нового вторгнення російської федерації на нашу територію

Ключові слова: політичний конфлікт, економіко-політичний конфлікт, управління конфліктами, російсько-українська війна..

Introduction. Every year, the world community is more and more often faced with new, non-traditional forms of wars and conflicts, which were the permanent result of the childish stage of international relations. For Ukraine, this issue is extremely relevant, as it is currently facing a number of threats and challenges, the main of which is the resolution of the military-political conflict and the restoration of the country's territorial integrity. Therefore, the search for ways to resolve this conflict is extremely urgent at this stage.

Conflict (from the Latin word «conflictus» - collision) is considered as one of the forms of social interaction, the participants of which can be individual individuals, groups of people, organizations, institutions, societies, countries, states, etc. Both internal (intrastate) and external (interstate) conflicts weaken the ability of any country to defend its national interests in the international arena. They can be used as a tool of pressure on the state leadership, forcing it to make unfavorable decisions. The problem of conflicting international relations in the modern globalized world is extremely relevant and occupies an important place in modern socio-humanitarian science. This includes the issue of the armed conflict on the territory of Ukraine, the constructive solution of which is of great practical importance both for Europe and the whole world.

Analysis of recent research and publications. It is known that the scientific understanding of conflict begins with the early formation of philosophical thinking and the development of fundamental concepts of conflict theory in the 1950s and 1960s. The analysis of scientific research in the field of philosophy, sociology, political science, and psychology shows that the theoretical, methodological and practical foundations of modern conflict theory are based on the achievements of the founders of the leading sociological and psychological theories of conflicts (M. Deutsch, K. Levin, D. Mead, K. Rogers, K. Horney) and others. It was these thinkers and scientists who initiated the process of institutionalization of modern conflictology, which studies conflicts at the micro-, meso-, macro-, and mega-levels [1; 2].

In the modern world, conflicts attract the attention of representatives of various fields of science (philosophy, sociology, conflict studies, political science, psychology, history,

jurisprudence, military science, cultural studies, ethnology, pedagogy, and others). Analyzing the historical stages of studying this issue, it should be noted that one of the first researchers who paid attention to this topic were R. Dahrendorf, L. Koser, G. Simmel and P. Sorokin. They studied the functions and mechanisms of conflict regulation and developed a functional theory of conflict.

In Ukraine, the phenomenon of military-political conflict is studied in the works of researchers V. Bezruchenko, O. Batrymenko, I. Izhnin, and S. Syroy. G. Perepelitsa considered this issue quite thoroughly, analyzing the essence of the military-political conflict.

Unfortunately, a deep understanding of the specifics of the armed conflict on the territory of Ukraine and the methods of its settlement has not been properly developed.

The formulation of the goals of the article. Various methods were used in the research, including the comparative-historical method, the method of source analysis, as well as induction, deduction, synthesis and analysis. This made it possible to gain a deeper understanding of the essence of political and political-economic conflict, as well as to divide political-economic conflicts into conflicts of values, interests, and identification, determining their essential causes.

Presentation of the main results. Military-political conflicts are one of the most widespread and dangerous social conflicts of our time. Various aspects of the occurrence, dynamics, solution and prerequisites for the prevention of armed conflicts in certain states and regions are the subject of numerous studies, which are an integral part of modern science.

According to I. Artsybasov's research, an armed conflict is «specific social relations formed between its subjects in the process of waging an armed struggle, which can take the form of a war, an international armed conflict, or an armed conflict of an international nature».

As E. Smith points out, «armed conflicts are open confrontations with the use of weapons between two or more parties controlled from the center, which continues continuously for a certain time in the dispute for control over the territory and its management». E. Smith's definition refers primarily to conflicts in which territorial contradictions are resolved, but the emphasis in it, as in I. Artsybasov's definition, is on armed struggle, the use of weapons.

Armed struggle can be a means of solving various social conflicts, such as economic, religious, ideological, etc.

In armed political conflicts, armed confrontation is the main means of achieving the goals of the parties in the sphere of political power. This, in turn, gives them the opportunity to realize their own interests with the help of a set of spiritual and informational, economic, normative and legal and power resources. Thus, the general subject of armed political conflict is political power as «the real ability of some people to exercise their will in relation to others with the help of legal and political norms».

Unlike other technologies of conflict management, the goal of settling military-political conflicts is to minimize damage and negative consequences for each of the warring parties, thanks to which the conflict itself becomes more productive. Basically, the settlement of the military-political conflict from the point of view of management theory is a process of purposeful influence on the conflicting parties with the aim of achieving a productive and agreed result.

The plan of practical actions for settlement includes a list of methods that must be effective and correspond to the nature of the military-political conflict. Based on the last requirement, some scientists divide these methods into two main groups: political and armed. In international practice, it is customary to call them civil and military elements.

In 1975, E. Mack, a British international scientist, came to an important conclusion: in most of the modern conflicts known to him, powerful countries were not defeated militarily, but were defeated in a political

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sense, because they could not impose their will on the opponent. The political victory of the Polish army consisted in the fact that by using mainly partisan methods of conducting military operations, it managed to use up the will of the whole nation to prolong the war and achieve its goals. Ukraine's current challenges in asymmetric resistance have two dimensions. In an external sense, we must find a supporter and not succumb to the imposition of an external, surely destructive for our depravity, the political will of a slave. And in the internal dimension - to ensure the dominance of our political will in problematic regions, not allowing them to exhaust us economically and politically.

Conflicts lead to heavy and inevitable losses for all parties. Politics often uses forceful methods of struggle, which do not give the desired result. Most often, there is a combination of political goals of a socio-political, economic, diplomatic, informational, military direction.

Experts believe that the greatest global and regional threat is the presence of nuclear weapons in various countries of the world, which could lead to the beginning of the Third World War with the use of weapons of mass destruction: nuclear, chemical, biological (bacteriological), seismic and psychotropic. The military potential of the countries of the world is given in the table. 1 where the leaders in terms of the number of nuclear warheads and weapons are: the USA, russia, China and India.

Table 1 – Countries with the world's strongest armies as of 2022*

Country	Active troops, people.	Defense budget, $ million	Number of nuclear warheads	Tanks, units	Navy, in tons	Airplanes, units
USA	1400000	577	3708	8800	3415893	13892
russia	766000	60	4489	12556	845730	3429
China	2333000	145	410	4950	708086	2860
India	1325000	38	164	4614	317725	1905
United Kingdom	147000	52	225	227	367850	936
France	203000	40	290	222	319195	1264
South Korea	624000	33	-	2331	178710	1412
Germany	179000	40	-	266	242508	663
Japan	247000	42	-	-	413800	1613
Turkey	411000	18	-	2229	148448	1020
Ukraine	800000	989,5	-	1890	25	240

Source: developed by the author based on research

Settlement of international conflicts takes place under the following conditions:

- the world community realizes that the use of military methods to resolve conflicts is ineffective and dangerous. This facilitates the transition from military actions to political dialogues and strategic communication. States and international organizations prefer negotiations and diplomacy to settle disputes, which reduces the risks of conflict escalation.

- the development of integration processes contributes to the destruction of interstate and interregional barriers. This creates conditions for the formation of unions, associations or state associations that pool their resources and efforts to ensure maximum cooperation. Such associations help reduce the possibility of conflict situations due to closer interaction and joint problem solving.

Thus, the key conditions for the settlement of international conflicts are the transition to political negotiations and strategic communication, as well as the strengthening of integration processes that contribute to the creation of strong alliances and associations to ensure stability and cooperation.

The conflict that is taking place in Ukraine and has already led to the annexation of Crimea and the failed resistance on the way to the country, in a number of cases, is mistakenly or unilaterally interpreted as exclusively hybrid the epic war between the russian Federation and Ukraine (the Ukrainian-Polish War). A narrow or one-pointed understanding of the cause of the conflict leads to the fact that the proposed ways of its mediation do not give the expected results.

Since international conflicts include various situations, such as interstate confrontations, crises, revolutions, hybrid wars, terrorism, and global or local conflicts, the current conflict in Ukraine can be described as a protracted international armed conflict of a neocolonial nature. This conflict arose as a result of the escalation of the hybrid war, which began long before 2014. Hybrid aggression on the part of the Kremlin against Ukraine (as well as against other independent states of the former Soviet space) is connected both with the intentions of restoring the USSR and with the aspirations of restoring the Russian Empire within the borders of 1913 [1]. Ukraine's course towards European and Euro-Atlantic integration has become a significant challenge for the Russian Federation, which views the European vector of Ukraine's development as a significant threat to its own geopolitical and neo-colonial interests. Thus, the events in Crimea and the East of Ukraine since the beginning of 2014 give reasons to consider military aggression by Russia as an international armed conflict of the neo-colonial type [1].

That is, Russia views Ukraine as an object of its influence and a key component of post-Soviet integration processes, with the desire to restore its «ectopic leadership» and strengthen its lost positions in the regions. which she considers to be a good point of influence, as well as to ensure the proper strength in global and European security architecture and cooperation.

Therefore, there is an urgent need for a way to mediate the Ukrainian-Polish military-political conflict. The peace, stability, and prosperity of not only both countries, but also other countries in the region of Eastern Europe, the South Caucasus, and Central Asia will depend on mediating the conflict and trying to resolve it [1].

The settlement of military-political conflicts can be achieved through various mechanisms and strategies, depending on the specific context of the conflict, the interests of the parties involved, and external conditions.

In his book «Great Shakivnytsia» in 1997, Zbigniew Brzezinski emphasized the importance of Ukraine for the security of the EU and even the world. In it, Professor Brzezinski pointed out that in the current cooperation in the Weimar Triangle (France, Germany and Poland), joined by Ukraine, such a group of states will become the basis of security, without being a threat to Russia and other participants at the same time international arena [16]. In connection with the fact that Ukraine's non-blockade has not been able to guarantee its security and ensure reliable protection of national sovereignty and territorial integrity, the issue is relevant integration of the mutual potential of our country into the existing system of Euro-Atlantic security.

The main ways of settling military-political conflicts are:

1. Negotiations and Diplomacy. Negotiations are one of the most important tools for achieving a political settlement of conflicts.

– Bilateral negotiations: Direct negotiations between the parties to the conflict without the involvement of third parties.

– Mediation: Involvement of a neutral third party to facilitate the negotiation process (for example, the UN, individual states, international organizations).

– Direct negotiations can be supplemented by preliminary consultations and preparatory meetings to develop an agenda and create an atmosphere of trust.

2. Peacekeeping Missions. Peacekeeping missions involve international forces to maintain peace and security in a conflict region.

– UN operations: UN peacekeeping forces enforce peace agreements and prevent a resumption of hostilities.

– Regional peacekeeping missions: For example, missions under the auspices of the African Union or other regional organizations.

3. Economic Sanctions and Incentives. Economic measures can be used both to put pressure on the parties to the conflict and to encourage them to make peace.

– Sanctions: Imposing economic sanctions on states or non-state actors involved in the conflict.

– Economic assistance: Provision of economic assistance, investments and resources for the reconstruction of post-conflict regions.

4. Political Reforms. Political reforms can help address the root causes of conflict.

– Decentralization of power: Granting greater powers to regional or local authorities.

– Inclusive governance: Ensuring representation of all key groups in political processes and institutions.

– Constitutional changes: Adoption of a new or amended constitution that takes into account the interests of all parties.

5. Justice and Reconciliation. Ensuring justice and reconciliation are key to lasting peace.

– International tribunals: Trials of individuals who have committed war crimes or crimes against humanity.

– Truth and Reconciliation Commissions: Investigating past crimes and human rights violations with the aim of uncovering the truth and promoting reconciliation.

6. Humanitarian Aid. Humanitarian efforts are aimed at supporting the civilian population during and after a conflict.

– Provision of humanitarian assistance: Provision of food, water, medical care and shelter to the population.

– Support for Internally Displaced Persons (IDPs): Assistance to people who have been forced to leave their homes due to conflict.

7. Role of Civil Society. Civil society can play an important role in reconciliation and reconstruction processes.

– Local NGOs and public organizations: Support for dialogue, mediation and reconciliation at the local level.

– Involvement of citizens: Active involvement of the population in the processes of decision-making and conflict resolution.

8. International Support. The international community can contribute to conflict resolution through diplomatic pressure, financial assistance and technical support.

– The role of the UN and other international organizations: Coordination of international efforts to resolve conflicts and support peace processes.

– Bilateral support: Involvement of individual states that can act as mediators or donors.

The settlement of armed and political conflicts is a complex and multifaceted process that requires a comprehensive approach and cooperation between various actors at the international, national and local levels.

Political compromise is one of the most effective tools for settling military-political conflicts. It consists in reaching an agreement between conflicting parties through mutual concessions and taking into account the interests of all interested participants. Political compromise is based on the desire for

stability, peace and cooperation, which is especially important in the context of modern international relations.

The main advantages of political compromise are:

1. Reduction of losses and damage: A political compromise allows avoiding further human and material losses typical of the continuation of hostilities.

2. Stability and peace: Reaching a compromise helps establish long-term stability and peace in the region, which positively affects socio-economic development.

3. Rebuilding trust: The process of negotiation and compromise can help restore trust between conflicting parties, which is critical for continued coexistence.

4. Preservation of international image: Participants who reach a political compromise demonstrate maturity and responsibility, which positively affects their international image.

Examples of successful political compromises are:

1. Dayton Accords (1995): Ended the Bosnian War by creating a complex but functional political system that kept peace in Bosnia and Herzegovina.

2. Goodfried Treaty (1998): The signing of an agreement between Great Britain and Ireland on the status of Northern Ireland, which helped to end years of conflict in the region.

But along with the advantages of political compromise, there are also challenges of political compromise, namely:

1. Difficulty in negotiation: Finding common ground between opposing parties can be very difficult because of deep differences in their goals and values.

2. Resistance from radical groups: Radical groups may perceive compromise as a betrayal and continue with armed actions or terrorism.

3. The need for concessions: Political compromise requires concessions from the parties, which are sometimes perceived as a loss of face or weakness.

The main conditions for a successful political compromise are:

1. Mutual respect and trust: Without a foundation of trust and respect for each other's interests, it is almost impossible to reach a compromise.

2. Involvement of neutral mediators: Neutral mediators, such as the UN or other international organizations, can play an important role in facilitating the negotiation process.

3. Willingness to make concessions: The parties must be ready for real concessions and changes in their initial positions.

There are two main models of peace in the Ukrainian-russian military-political conflict - «Autonomization» and «Occupation» [4].

The «Autonomization» model provides for the granting of autonomy to the part of Ukraine that is under Russian control - the creation of the Autonomous Eastern Republic. There can be no language for the expansion of Russia's computer technology. Autonomy provides for the juridical stay of the territory within the structure of Ukraine, and therefore, the extension of the effect of all the laws of Ukraine on this territory. Autonomy foresees its own Parliament and its own Upad on this topic. That is, everything is being built according to the Kryma model, as it is recommended in the Constitution of Ukraine. This also means payment of expenses from the current budget for pensions and salaries to budget officers. This also means the conclusion of a special economic agreement with the Autonomy, where the rules of transportation, the functioning of the infrastructure, and other things are foreseen. However, this also means the absence of national independence in this typology. If the protection of the Ukrainian state is not attached to this tepitopia, that is, if the tepitopia has its own state, then this will mean its exit from the structure of Ukraine. Therefore, Tepitopia is fully under the protection and jurisdiction of the Ukrainian government.

Thus, in this case:

1. Ukraine must control the Ukrainian-Polish cooperation;

2. all Polish eyelashes leave tetopyia;

3. all military equipment is removed from the territory of Ukraine, or, if it is left on the territory of Ukraine, it will be nationalized;

4. all military and illegal formations are created together;

5. Ukraine guarantees amnesty for the actions of former militants, militias, and illegal formations, which did not involve military servicemen of the failed forces of Ukraine and a false intention before the conclusion of the agreement, but only in respect of military actions and only until the moment of conclusion of the agreement. Why are all military actions already qualified as war crimes;

6. pardon will not be sent to unmotivated objects of false purpose, which are pursued, and those guilty of this will be buried;

7. amnesty also does not extend to tepopism and banditry with regard to peaceful purposes, as well as to fraud. This is still being investigated and the culprits are not being punished;

8. russia reports all Ukrainian criminals to Ukraine for investigation of their criminal activities against Ukraine. This process continues until it is fully published.

The «Occupation» model is the adoption of a law on the temporarily occupied territory, which falls under all the sanctions to which the occupied territory currently falls. With this occupied territory, very limited economic relations of Ukraine are possible, but within the framework of a clear Agreement, which is also agreed upon by Ukraine with the majority of the countries that are to enter the territories.

Ideally, the Ukrainian-russian military conflict can be settled through political and diplomatic means.

For this, several key strategies can be used: the strategy of «smart power», the strategy of complex response to current challenges and threats, as well as the strategy of multi-level settlement of armed conflicts [6]. Among them, the main role is played by the «smart power» strategy, which is based on the combined use of «hard» and «soft» methods, which allows to achieve better results than using any of them separately [2]. Ukraine should implement a «smart power» strategy in order to effectively resist the pressure of the former imperial center and preserve its independence, using both «hard» and «soft» resources. This strategy involves the use of political, legal and diplomatic means of influencing the aggressor country, negotiations and mediation, as well as multilateral and multi-level influence on the course of the armed conflict, including peacekeeping operations and other forms of intervention [3].

Ensuring the integrity of Ukraine is one of the most important tasks of the authorities, especially in the conditions of modern geopolitical challenges and threats. A comprehensive, scientifically based approach is necessary to successfully solve this task for several reasons:

Diversity of challenges: modern threats to the integrity of Ukraine are not homogeneous and require diverse strategies and appropriate measures. For example, military aggression, information warfare, economic pressure - all these factors require different methods of countermeasures.

Constant changes: the geopolitical situation is constantly changing, and the Ukrainian authorities must be ready to adapt to these changes. Flexibility in solving problems allows you to effectively respond to new challenges and opportunities.

Optimal use of resources: an accurate assessment of the situation allows you to avoid the dispersion of efforts and mobilize resources where they are most needed. A science-based approach helps to develop more effective strategies.

Adequate response to the actions of the aggressor country: the response to the actions of the aggressor country must be well-founded in order to prevent the escalation of the conflict and maintain international support [2].

In the legal sphere of the post-conflict society, the strengthening of law and order is important for restoring stability and ensuring the development of the country after the conflict. Carrying out reforms in all bodies and power structures is necessary to create an effective and democratic management system that will contribute to the economic and socio-cultural development of the affected regions and the entire country in general.

The protection of human rights and freedoms is a fundamental principle of any democratic society, especially in the post-conflict period, when there is an increased risk of human rights violations. The development of civil society contributes to the strengthening of democracy and increased participation of citizens in decision-making, as well as the restoration of trust between citizens and the authorities.

Harmonization of relations between different regions of the country is necessary to ensure the unity and integrity of the national society. The restoration of the national security system includes the strengthening of the country's defense capabilities and the development of the law enforcement system to ensure the safety of citizens and the protection of state interests.

Therefore, in the legal sphere of the post-conflict society, the implementation of reforms, the protection of human rights and freedoms, the development of civil society, the harmonization of relations between different regions of the country, and the restoration of the national security system are key aspects for the creation of a stable and prosperous society.

In the economic and environmental spheres of post-conflict reconstruction, comprehensive work is needed to ensure stable and sustainable development. Some justifications for the importance of these directions:

Macroeconomic Stabilization: Macroeconomic stability is the basis for economic growth and social stability, namely inflation control, budget management, currency market stabilization and other measures aimed at ensuring economic balance, as well as raising the standard of living of the population.

Improving economic and environmental conditions: that is, attracting investments and ensuring sustainable economic growth promotes the development of effective environmental protection mechanisms, the creation of new jobs, which allows for stability for business and investors.

Infrastructure recovery: The recovery of transport, energy and social infrastructure is a key step in post-conflict recovery. That contributes not only to the efficient functioning of the economy, but also improves the quality of life of citizens.

In the field of socio-cultural and psychological development, it is necessary to strengthen the system of medical care, education and social security, which will contribute to the creation of an atmosphere of mutual understanding, trust and cooperation, as well as contribute to the restoration of mental health and long-term peaceful coexistence. It is important to ensure optimal conditions for the return of refugees and internally displaced persons, their constructive reintegration and the satisfaction of basic needs such as job search, housing and medical assistance. It is necessary to carry out measures for psychological support, social rehabilitation and reintegration into society of former combatants, forced migrants, refugees and civilians who were in the conflict zone. The start of work on reintegration should take place only after the cessation of hostilities and the establishment of a peaceful situation in the affected regions, because only in peaceful conditions is it possible to complete de-occupation, normalize the life of the population, and restore the mental health of refugees and displaced persons.

The crisis in Ukraine requires a comprehensive approach not only by the United States, but by the West as a whole. In the framework of the Western public policy in terms of the political crisis, it is necessary to

monitor authoritative media communications, as well as to search for patient connections in moments of deep conflict the day's propagandistic headlines that flatter society.

It is necessary to emphasize what Zbigniew Brzezinskii drew attention to in each of his speeches on the topic of the year: giving the state the opportunity to get out of a permanent conflict in any situation. The overly aggressive steps of the West, which compromise the Kremlin and weaken the Russian government, may have global consequences, according to the president. This is connected with the system of power in the country, where the rich oligarchs, who own huge financial assets, are covered by extremely radical ideologies and have been fighting for them for a long time power with the current president. Therefore, first of all, unofficial negotiations between the USA, EC and Russia are necessary, but without fail with the participation of the Ukrainian authorities, in order to force the Kremlin to stop military actions on the territory of Ukraine. It is also important to allow all Ukrainians to accept the decrees and guarantee their observance, as is the case in all democratic countries [13, p.85].

We believe that the only option for preserving the Ukrainian state is joining the Euro-Atlantic community. NATO, in its program document - the Washington Agreement of 1946, defines a number of clear and transparent provisions, perusal of which will convince an unsuspecting average citizen of the absence of any reservations regarding the rights and security of third countries. The five essential requirements for NATO membership candidates clearly and concisely formulate our desired relationship both in the entire North Atlantic Union and with countries not members of NATO.

Applicants for NATO membership have clear requirements: «The applicant country must comply with the basic principles of the Washington Treaty» [12].

The applicant country is required to:

– it is better to write out inter-day vouchers in the correct way;

– secondly, to demonstrate devotion to the principles of good governance and human rights;

– thirdly, to resolve international conflicts and external territorial disputes in a peaceful manner, including issues of internal jurisdiction in accordance with the principles of the OSCE and with the aim of pursuing the goal renewal of welfare relations;

– fourthly, to establish proper and democratic civilian control over all the failed forces;

– fifth, refrain from threats of force or actions or any method that does not correspond to the purpose of the UN. To promote the development of international and friendly relations by strengthening their free institutions and, thanks to the strengthening of stability and well-being, continue to provide full support and help in the case of the Euro-Atlantic partnership, the program «Partnership of the West» and the development of cooperation with partner countries that are not members of NATO.

It is worth noting that obtaining membership in the EU and NATO is the most effective way to strengthen Ukraine's security. The main problem with such a strategy is that it requires time, which is not available in Ukraine.

Responding to the needs of reforming the political system and economy of Ukraine in the most complete way, such a path can last for decades. Its purpose is that in order to achieve success, Ukraine is the most effective part of the collective security system in the world.

For all these reasons, it is possible that the last week of the year will be maximum. Overcoming this problem may turn out to be too difficult a task. However, keeping the issue of NATO membership on the agenda is fundamentally important for strengthening Ukraine's position.

With the acceptance of the country, the Ukrainian authorities are forced to review the threats facing the country, and to establish what, exactly, is the importance of collective security contributed to the potential

integration of Ukraine into NATO, but nevertheless the prospects for this membership for us remains, although not in the near future.

Conclusions. Theoretical developments and accumulated empirical data related to the study of the features of the deployment, course of armed conflicts and exit from them are of great practical importance, as they help to determine the optimal strategies for the approach to conflict resolution and stabilization of the vital activities of Ukrainian society. This knowledge is important for the implementation of the processes of deoccupation and reintegration of the population of the territories affected by the armed conflict.

The integrative approach involves the use of several main strategies:

1) «smart power» strategies;

2) strategies for comprehensive response to current challenges and threats;

3) strategies of multi-level settlement of armed conflicts.

One of the most important among them is the «smart power» strategy, which is focused on long-term results. The use of these strategies makes it possible to strengthen the international pro-Ukrainian coalition, improve state policy, prevent further violence, establish peace, and ensure international and national security.

Also, an important tool in the settlement of military-political conflicts is political compromise. It provides a peaceful way to resolve disputes, preserves human life and promotes long-term stability. Although the process of reaching a compromise can be difficult and require considerable effort, the results are usually worth the resources and effort.

Therefore, in conclusion, it should be noted that in order to be able to restore the lost topias in the future and to restore its sovereignty, Ukraine needs to invest as much as possible now the country's melons are full, as well as internationally. Convince the entire society and the international community that Donbas and Kym are temporarily occupied territory of Ukraine, from which it will not give up under any circumstances sooner or later I will bring them to the whole structure. It is important that discussions about the recovery of lost tapes should include not only Donbas, but also all the occupied territories of Ukraine. Crimea and other occupied regions must always look out for each other. Unfortunately, Russia is still trying to share information about these groups.

The Ukrainian authorities should ensure the implementation of active holiday work in the pre-emptive areas with the immediate benefit of social and economic impact. It is extremely important that development programs are implemented with the active involvement of European organizations in order to dispel all myths about the EC and NATO, in particular, and the Kyiv authorities in general. Comprehensively help refugees from the occupied territories loyal to Ukraine and those who contribute to the protection of its interests in the eastern-southern periphery. This will mean that Ukraine as a country takes care of its citizens..

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INNOVATIVE TECHNOLOGIES IN THE LOGISTICS SYSTEM

Nadiia Reznik. «Innovative technologies in the logistics system». *This article highlights the importance of the latest technologies and innovative logistics as the most effective element of the logistics activities of enterprises. The essence of the most modern and progressive technologies is described in detail, their advantages and features of implementation in real-time conditions are determined. The impact of these technologies on logistics and supply chains is analyzed. It has been established that the participants of the logistics chain are able to create a transparent and effective system of transaction recording, asset tracking and documentation management using the most promising innovative technologies in the logistics field. The effects that the subjects of the logistics chain receive from the introduction of the latest technologies are outlined. It has been proven that the use of progressive innovations in logistics can ensure the growth of the effective activity of any enterprise, reduce the total costs for the implementation of flow processes and improve the quality of customer service as a whole.*

Keywords*:* innovative logistics, latest technologies, logistics system, innovative technologies, logistics process management

Надія Рєзнік. «Інноваційні технології у логістичній системі». *У статті висвітлено значення новітніх технологій та інноваційної логістики як найбільш ефективного елементу логістичної діяльності підприємств. Детально описано сутність найсучасніших і прогресивних технологій, визначено їх переваги та особливості впровадження в умовах реального часу. Проаналізовано вплив цих технологій на логістику та ланцюги поставок. Встановлено, що учасники логістичного ланцюга здатні створити прозору та ефективну систему реєстрації транзакцій, відстеження активів та управління документацією, використовуючи найбільш перспективні інноваційні технології у сфері логістики. Окреслено ефекти, які отримують суб'єкти логістичного ланцюга від впровадження новітніх технологій. Доведено, що використання прогресивних інновацій в логістиці здатне забезпечити зростання ефективної діяльності будь-якого підприємства, знизити сукупні витрати на реалізацію потокових процесів і підвищити якість обслуговування клієнтів в цілому.*

Ключові слова: інноваційна логістика, новітні технології, логістична система, інноваційні технології, управління логістичними процесами.

Introduction. Technological innovation plays an increasing role in all sectors of the economy, and logistics and supply chain management in the enterprise cannot remain aloof from this process either. And since large volumes of data are actively used in the field of logistics, which are stored separately and in different programs, and are very often entered manually, it is possible that logistics

will benefit more from the introduction of new innovative ways of working.

Innovations in the logistics sector are determined not only by the desire of logistics companies to implement new technologies in order to keep up with the development of the industry. A significant role in this process is played by representatives of trading businesses and large industrial enterprises, which strive for their goods and services to reach consumers faster and at lower costs.

Logistics trends depend on significant changes caused by the introduction of logistics technological solutions into business processes. In particular, next-generation logistics technologies make global supply chains more customer-oriented and sustainable, and the automation of logistics processes significantly increases the productivity and efficiency of the work process. Therefore, increasing the transparency and traceability of the supply chain is essential to create a flexible and dynamic relationship between the various stakeholders.

According to Research and Markets, the market was valued at USD 9407.5 billion in 2023 and is likely to grow to USD 15978.2 billion by 2032, representing a CAGR of 6.4%. In particular, technology in logistics is constantly evolving, and in 2025 we can expect major changes, from new logistics innovations to changing consumer behavior.

Analysis of recent research and publications. Many Ukrainian and foreign authors studied the development and implementation of logistics innovations. In particular, Smirnova N.V. studied the works of scientists who studied different approaches to defining types of logistics innovations and directions of innovative development in logistics [1, p. 169–180]; Boldyreva L.M. on the basis of links of the logistics chain and functional types of logistics classified logistics innovations [2, p. 18–23]; Malukalo O.O. formed the principles of logistics management and effective logistics support [3, p. 18–23]; Rudenko S.V., Pylypchuk K.M. studied the main characteristics of the concept of supply chain management and logistics system [4, p. 95–102]; Podra O.P., Gomza K.I. formulated the main technologies of automation of warehouse activities of enterprises [6, p. 70–78]; Fedkovich I.V. determined directions for improving logistics activities at the enterprise [7, p. 111–113]; Mishchuk I.P. and Mariy O.T. studied the main areas of management of logistics business processes [8, p. 153–159]; authors Smerichevska S.V. and Kryvoruchko G.O. formulated the methodological and theoretical foundations of effective management of logistics processes [10]; Mayorova I.M. used a strategic management approach to identify logistics innovations, basing them on four logistics concepts [11, p. 326–348]; Pity M.S. noted that the management of innovations in logistics should be formed on the basic logistics circuit, which includes units of supply, transportation, storage and sales [12, p. 59]. Mulyarchyk M.B. and Krykavska I.V. emphasized the important role of information technologies in logistics innovations [13, p. 73]; Testard M. (Testard M.) claims that «innovations in the field of logistics will provide logistics enterprises with significant opportunities to position themselves as value creators and change their operating models towards greater flexibility» [14]; Mitchell-Keller L. (Mitchell-Keller L.) notes that innovative logistics systems allow retailers to track the location of goods in real time and compare planned and actual logistics flows for a timely response to force majeure [15]; Sigida L.O. and Tsunenko A.M. emphasize that effective management of logistics activities ensures the production process, covering all stages - from the supply of raw materials to the distribution of finished products, which allows to deliver products to the consumer with minimal costs [16, p. 112]. Mykhalytska N.Ya. and Veresklya M.R. point out that fierce competition requires new approaches to planning and managing product flows, based on the principles of logistics, which helps to increase the competitiveness of enterprises [17, p. 7].

Materials and Methods. The theoretical and methodological basis of the study were the provisions and developments of domestic scientists, as well as foreign experience in the field of logistics, theory and practice of management in logistics, along with the author's personal assessments. Analytical and abstract-logical methods were used during the research. The use of methods of analysis and synthesis made it possible to determine innovative forms of logistics management that are currently being implemented in the field of logistics. The method of structural comparative analysis helped to determine the main components of the digital supply chain management system model. The method of expert assessment contributed to the identification of key areas of logistics activity of enterprises that require the implementation of innovative approaches and improvement of the logistics management system.

Presentation of the main results. In today's world, where the speed and efficiency of transportation play a key role, logistics companies of Ukraine have a significant impact on the development of the national economy. They ensure the uninterrupted movement of goods between producers and consumers, which contributes to the stable functioning of various industries. Logistics is an important component of the supply chain, which covers not only the transportation, but also the storage, processing and distribution of goods.

But advances in technology aren't the only big changes affecting the industry. New shipping regulations, growing global tensions, trade wars, the pandemic, martial law in Ukraine, the spread of e-commerce and online retail require logistics companies to quickly adapt to changes in the market environment.

In the conditions of globalization and growing competition, efficient logistics is becoming a decisive success factor for many enterprises. They are able to offer comprehensive solutions that include all stages of the logistics process, from planning to execution control.

Today, logistics companies of Ukraine face a number of challenges that require constant improvement and innovation. One of the main challenges is the state of the infrastructure. Despite significant investments in road and railway modernization, there is a need for further improvement of the transport network. An important aspect is the development of port infrastructure, which plays a key role in international trade.

In addition, global changes in the logistics industry, such as the transition to a green economy and the introduction of energy-efficient solutions, also create new opportunities for Ukrainian logistics companies. The use of alternative types of fuel, electric vehicles and the implementation of energy management systems can reduce the environmental impact and lower fuel costs.

Digitalization is another important trend that opens up new opportunities for logistics companies. The use of the Internet of Things (IoT), blockchain technologies and process automation helps to increase the efficiency of supply chain management. These technologies make it possible to reduce the risks associated with the human factor and ensure high accuracy of logistics operations. Companies in logistics and supply chains must continue to prepare for all of these big changes by leveraging innovation.

Let's analyze these innovations in logistics activities at enterprises carrying out the transportation of goods:

1. Internet of things.

IoT involves connecting physical devices to track and transmit data over the Internet without human intervention. The use of IoT in logistics improves transparency at every stage of the supply chain and increases the efficiency of inventory management. In other words, the integration of IoT technology into logistics and supply chain operations can increase efficiency, transparency, and real-time visibility of goods. For example, during

transportation, IoT makes it easier to monitor temperature and humidity for sensitive goods, thus maintaining product quality and compliance with regulatory standards.

The impact of the IoT on the logistics industry extends even further, allowing logistics companies to use predictive analytics to anticipate fluctuations in demand. Such solutions also optimize routes and planning, and minimize environmental impact by tracking fuel consumption. This contributes to sustainable and environmentally friendly supply chain practices.

Ambrosus has created an IoT network for the food and pharmaceutical supply chain. The network provides data analytics tools, shared sensors, distributed ledgers, and databases for supply chain management. Fleetroot's IoT platform, which is used by companies, also allows them to manage their fleets. With the help of sensors and devices implanted in the vehicle, the platform monitors the functioning of the vehicle and notifies the system [20].

2. Artificial Intelligence.

Logistics companies are responding to demand fluctuations in advance using artificial intelligence and machine learning algorithms. For example, AI can help managers plan supply chain processes and reduce inventory losses by forecasting. In addition, companies are using AI to optimize route planning and consolidate cargo, which in turn reduces fuel consumption and carbon dioxide emissions, supporting overall sustainability efforts. Customer service and supply chain communication have also been improved with the help of chatbots and virtual assistants managed by artificial intelligence.

AI-powered robots and drones increase efficiency and reduce labor costs for tasks such as inventory counting and last-mile delivery. Additionally, to improve the security and compliance of logistics operations, AI-driven robots are used for risk assessment and fraud detection systems. This allows logistics companies to automate security tracking and protect shipments, reducing financial losses [21].

Australian firm Adiona has developed an AI-based service (OSaaS) for optimization software to help businesses improve logistics processes and reduce costs. Using machine learning, the system can predict factors such as demand, weather and traffic. That is, we can claim that this approach allows reducing the number of people needed for manual input.

Insite, a New Zealand-based startup that creates AI-based software solutions for price and demand forecasting, as well as flow and process optimization, mainly serves the retail industry. This platform offers tools for risk assessment and demand forecasting. That is, it contains modules for collecting and combining real-time process data. This allows managers to be well-prepared to manage product replenishment and ensure that information is up-to-date.

3. Robotics.

The integration of robotics into logistics increases the speed and accuracy of supply chain processes and reduces the likelihood of human error. Robots ensure long-term uninterrupted operation and increase productivity compared to human labor. However, robots do not replace people, but complement their work, increasing overall efficiency.

Physical robots, i.e. collaborative robots (cobots) and autonomous mobile robots (AMRs), are used to pick and transport goods in warehouses and warehouses. In addition, software-based robots, by performing repetitive and routine tasks, allow people to free up time for more complex and important functions [20].

According to the «Global Customer Report», testing of robotics in warehouses increased the efficiency of operations by 18%. Among the companies that are leaders in the use of robots in warehouses, we can highlight: Amazon, IKEA, Tesla, DHL, Coca-Cola and others.

4. «Last mile» delivery.

Challenges such as traffic congestion, customer preferences, and regulatory complexities are driving significant technological changes in last-mile delivery services. Companies are looking for alternative delivery methods, such as drones and autonomous robots, that can provide more efficient delivery. Micro fulfillment centers strategically located in urban areas are reducing delivery times, and crowdsourced delivery platforms are utilizing local resources for flexible.

Instant or same-day delivery meets consumers' growing demands for speed. What's more, it's intelligent hidden cameras, data-driven routing, and sustainability initiatives that contribute to increased convenience, efficiency, and environmental responsibility. Improved experience and collaborative logistics are key tools to meet changing customer expectations and optimize efficiency [23].

The Irish company Manna provides restaurant chains with a delivery service using a fleet of drones. These drones can fly up to 90 meters at a speed of 90 km/h. Drone delivery helps to solve the problem of last-mile congestion by allowing drones to reach remote areas, reducing delivery times and costs.

In 2021, the Ukrainian company Nova Poshta, which changed its name to Nova, successfully tested the delivery of a parcel by drone from Kyiv to Lviv. It is expected that the company «Nova» can create an engineering firm that will deal with solving the problems of transporting goods with the help of drones. The company is currently testing drones from several Ukrainian manufacturers: Ukrspecsystems, Aerodrone and Betterfly. Drones have the potential to deliver goods to cities and regions with underdeveloped transportation infrastructure and areas with no quality roads. In this way, last-mile delivery enables on-demand, pickup or courier companies to reduce out-of-pocket costs and reduce time to market.

5. Warehouse automation.

Automated warehouse technologies include automated guided vehicles (AGVs), robotic picking systems, automated storage and retrieval systems (ASRS), and wall-mounted kits. They optimize warehouse operations and additionally affect the last-mile delivery phase. Warehouse automation reduces errors and increases productivity, and ensures that products are accurately picked, packed, and ready for shipment.

At the same time, synchronizing advanced automation solutions with last-mile logistics systems ensures a seamless flow of goods, resulting in faster and more accurate delivery. Thus, warehouse automation becomes an integral part of the larger logistics ecosystem, optimizing logistics operating costs and improving last-mile delivery [20].

The French company Exotec is creating Skypod, an automated e-commerce warehouse optimization robot that optimizes storage space by using a vertical storage method to increase warehouse height to 12 meters.

ASRS software is used in the management of storage of products and materials in automated warehouses, it improves the use of space and does not require the involvement of manual labor for operation, together with allows to reduce the total operating costs and increases safety.

6. Blockchain.

The decentralized blockchain ledger ensures the integrity and immutability of transaction records. This system addresses the need for secure and tamper-proof documentation in complex logistics supply chains, increasing security, transparency, and efficiency. Thanks to the blockchain, participants in logistics operations can receive accurate information about the movement and status of goods in real time, ensuring full visibility and traceability.

A key feature of blockchain is smart contracts, which can automate and optimize various aspects of logistics, including customs clearance and payment processing. These

self-executing contracts speed up approvals and reduce processing times at checkpoints, speeding up the entire supply chain. With the spread of blockchain, trust between participants increases, administrative burden decreases, and the safe and efficient flow of goods around the world is ensured [19].

Steamchain proposed a blockchain platform that uses World Trade Logistics (WTL) smart contract systems to simplify payment processes. With WTL smart contracts, you can make B2B payments and prevent fraud, and together with you ensure an immutable record of all transactions. In addition to eliminating currency conversion costs, WTL smart contracts allow companies to minimize the costs associated with currency fluctuations.

7. Big data and analytics.

Warehouse operations benefit from data-driven insights to improve productivity by optimizing layout design, inventory placement, and order picking strategies. Logistics companies use big data to monitor location and weather conditions in real time, enabling them to dynamically adjust routes and improve delivery plans, thereby reducing delivery times and fuel consumption.

Market data analysis facilitates strategic decision-making that optimizes logistics service providers' relationships with suppliers of goods, adjusts pricing strategies, and manages inventory levels more effectively. In addition, the integration of big data and analytics enables the creation of comprehensive risk management reports, identifying anomalies and trends, allowing companies to proactively address potential disruptions and vulnerabilities in the supply chain.

The proposed AI solution of the American company Nautilus Labs helps maritime companies to reduce fuel consumption and increase efficiency. This software analyzes historical travel data and predicts the optimal speed and fuel consumption. The data generated by the cloud platform about the ship's characteristics subsequently helps to optimize fuel costs.

FACTIC, an American startup, has found a solution for the food and beverage industry and offered a SaaS platform for predictive analytics. FACTIC uses data mining and AI methods to predict future sales by analyzing data from internal and external sources. The platform predicts demand fluctuations and makes data-driven decisions to automate procurement and provides tools to optimize inventory through automatic replenishment.

8. Cloud computing.

Cloud-based SaaS solutions are transforming the logistics landscape by providing scalable and cost-effective solutions. Logistics companies are using cloud-based SaaS platforms to provide pay-per-use models that reduce the need for significant investments in IT infrastructure. This approach minimizes financial risks and allows businesses to allocate resources more efficiently. Cloud-based applications also simplify global logistics management by eliminating geographic restrictions.

In addition, cloud-based logistics solutions can solve communication problems, thereby providing secure and accessible platforms for collaboration. By providing centralized communication, supply chain participants can easily share data and information, improving coordination and responsiveness. In addition, cloud integration simplifies the collection of data from different management systems to analyze and optimize overall processes. A data-driven approach leads to better decision-making, increased efficiency, and improved customer service.

ESTOKO Logistics is a Spanish startup that develops cloud-based logistics solutions and provides warehousing services. It allows companies to centrally and securely manage logistics storage. In addition, the startup's cloud platform offers dashboards and reports to better manage warehouse operations and integrates with enterprise resource planning (ERP) systems.

The use of blockchain on the platform further ensures end-to-end data transparency, increasing the trust of

stakeholders throughout the supply chain. Together, these features allow companies to manage multiple warehouses and unify billing, while reducing transportation costs and shortening service times to destinations.

SaaS Inet is a cloud-based transportation management system created by Belgian startup Alpega to provide a full range of transportation services that connects manufacturers with a wide network of logistics service providers in real time. Inet TMS automates logistics processes and integrates transportation needs into one system. In addition, this software solution allows for shipment tracking via a mobile application. The cloud-based platform allows Alpega to release software updates to customers on a quarterly basis, as opposed to on-premises programs that are updated annually.

9. Autonomous vehicles.

One of the upcoming trends in logistics is autonomous vehicles, which increase safety by eliminating the risk of human error, such as driver fatigue and distraction.

This gives the company a guarantee of safe and reliable transportation of goods, thereby reducing the costs associated with possible accidents. They are used both in the first and last mile. By operating continuously, autonomous vehicles help improve supply chain efficiency and enable fast and flexible delivery, especially in cities. Another benefit of autonomous vehicles is promoting environmental sustainability. With the help of the methods they use: dilution on long routes, reduction of wind resistance and fuel consumption, the efficiency of fuel use increases. In addition, the use of advanced artificial intelligence technologies makes it possible to reduce fuel consumption and emissions by optimizing travel routes to avoid traffic jams and choose the most efficient routes [23].

The Spring X1 autonomous SUV from the German startup Spring transports goods using predictive intelligence. The modular trailers that Spring's autonomous vehicles are equipped with can be customized depending on their application, such as mobile warehouses, food and cargo delivery.

For example, South Korean self-driving cargo transportation startup Mars Auto has developed AI-based software for self-driving vehicles that includes tools for mapping the environment, monitoring, and directing vehicles to the correct cargo bay. In addition, it helps shipping companies deliver cargo efficiently, reliably, and safely without human driver intervention.

10. Elastic logistics.

During periods of fluctuating demand, companies use elastic logistics to manage their operations efficiently, allowing them to quickly increase or decrease their supply chain operations in response to market changes. During periods of high demand, companies can quickly increase their production, transportation, and warehousing capacity to meet growing customer orders. Conversely, during less active periods, capacity can be reduced to avoid unnecessary costs of excess resources.

This approach prevents underutilization of ships and vehicles by adjusting capacity to demand, which reduces costs and environmental impact. Elastic logistics is able to mitigate warehouse and storage constraints by dynamically adjusting space requirements, which in turn solves the problem of excess inventory by allowing companies to adjust inventory levels to actual demand, reducing operational costs and moral hazard, product obsolescence [23].

Shorages, a startup based in the United Arab Emirates, is a B2B on-demand warehousing marketplace for small and medium-sized enterprises (SMEs). Through its extensive network, Shorages helps businesses find short-term storage space. In other words, the platform allows owners to rent unused space in their warehouses to meet short-term needs, and offers pay-per-use, on-demand storage, and order fulfillment services to customers.

The GlassWing platform offered a wide range of commercial vehicles for freight transportation on demand. It has created a

network of logistics services that connects cargo owners with carriers. Using artificial intelligence technologies, the startup provides solutions such as real-time tracking and alerts, route optimization, and individual cargo safety reports, thereby reducing transportation costs.

11. Green Logistics.

Sustainable development is a movement that has spread to many industries, including logistics. Currently, more and more businesses are implementing various technologies to reduce their negative impact on the environment. The high dependence on fossil fuels, the impact of transportation, the constant carbon footprint and the need for human intervention, among many others, are key factors in this trend [23].

Amazon recently announced its «Climate Pledge» to achieve its environmental goals. It aims to engage other companies in its efforts to become carbon neutral by 2040 and support renewable energy sources. To confirm its intentions, Amazon has signed an agreement with Rivian for the production of electric vehicles for the supply of 100 thousand electric vans.

Deutsche Post, another of the world's largest courier companies, has also allocated $552 million to develop light transport electric vehicles and micromobility units. A leader in sustainable packaging solutions, CJ Logistics has implemented zero-waste practices through minimal packaging and environmentally friendly materials, developing innovative packaging materials and smart packaging solutions.

CJ Logistics, in collaboration with partners such as Moorim Paper, has integrated environmentally friendly paper filling materials into logistics operations and reduced the use of plastic. Switching all packaging materials to environmentally friendly alternatives not only protects the environment, but also increases productivity.

12. Digital twins are an accurate simulation model of an existing supply chain that uses operational data and information about the state of its real prototype to determine its future behavior. This technology allows you to create virtual copies of objects or processes and has a wide range of applications in logistics, in particular in warehouses – for modeling premises, planning and adjusting routes, schedules and reverse logistics processes [5; 6]. Managers understand that real goods will always differ from their computer models, which do not take into account the current state of parts, and that logisticians can quickly change specifications to meet consumer needs.

Datumix from the United States has developed a virtual 3D simulation for the main equipment. It uses machine learning to create digital doppelgangers that allow real-time monitoring of hardware performance before implementing algorithms. Data from these 3D models, along with artificial intelligence, is used to service the equipment.

The German company Cognition Factory offers the CognitiveFlow solution, which is based on artificial intelligence for modeling warehouses. This software is designed for planning, designing and managing mobile robots and material handling systems in the warehouse. CognitiveFlow integrates data from both local sources and other systems.

13. Augmented Reality.

In 2024, augmented reality (AR) will transform logistics, enabling real-time statistics and improving operational efficiency. AR-based wearables provide instant access to data, which increases productivity and reduces errors. AR also improves security by monitoring shipments and resolving issues quickly, which in turn improves customer satisfaction.

With the Vision Picking pilot project, DHL is using augmented reality (AR) in logistics. This project integrates AR smart glasses into warehouse processes, providing employees with digital picking lists and optimized routes that reduce movement. Thanks to the ability to scan barcodes, smart glasses guide employees to the right places and items on the shelves. Such an implementation allows to increase the efficiency of picking by 25%,

improve productivity and reduce the number of errors.

With all the advantages of introducing new technologies into logistics activities, there are certain problems and disadvantages that should be taken into account, in particular:

1) coordination. When carrying out international transportation, certain technical failures may occur during the coordination of logistics activities. As a rule, the most frequent problems are: language, schedule, cultural changes, mentality, introduction of new technologies at different rates in different countries of the world.

2) large and multinational companies. The essence of this problem is that the logistics sector includes very large companies that have a huge influence on this segment of the market because they have a lot of equity capital that allows them to introduce new technologies faster and offer cheaper services. This is how they can create a threat of destruction of the competitive environment due to the bankruptcy of medium and small companies.

3) legislation. In logistics, legislation has a great influence both on the level of customs policy laws and on the entry and exit of goods [22].

Therefore, logistics enterprises constantly need development and improvement, as well as a detailed study of all possible influencing factors and an individual approach to each innovation. Science is constantly developing, new technical inventions appear, which are successfully implemented by logistics companies, which significantly simplifies the process of material and technical support of production and increases the efficiency of their activities

The use of innovations will contribute to the optimization of logistics flows, which will make it possible to obtain an economic effect and increase the competitiveness of not only logistics centers, but also partners in the market of goods and services.

Conclusions. Thus, the development of logistics in Ukraine has significant potential for further growth, thanks to the introduction of innovative technologies, infrastructure improvements and adaptation to new market conditions.

Consequently, with ever-increasing consumer expectations and a shift in interests towards product diversity and personalized services, pressure on logistics companies and supply chains is growing. Businesses are faced with a difficult choice of various new technologies, such as IoT, automated mobile robots, artificial intelligence, and blockchain solutions to invest in. As technological advances continue unabated, it is important for companies to identify potentially disruptive changes to the marketplace at an early stage...

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ECONOMIC SECURITY OF THE ENTERPRISE: MODERN CHALLENGES AND THREATS

Alona Zahorodnia, Tetiana Fedorenko. "Economic security of the enterprise: modern challenges and threats". *In this article is defined and analyzed the concept of economic security of enterprises. The article examines various aspects of economic security of an enterprise, in particular, the classification of threats that may adversely affect its activities. Internal and external threats, their sources, nature, probability of realization and possible consequences are characterized.*

The methods of neutralizing these threats are considered, in particular, the possibility of creating a sustainable system of economic security at an enterprise and measures to minimize risks and threats are considered.

The principles and stages of implementation of security measures that allow an enterprise to more effectively withstand potential challenges are presented.

Keywords*:* economic security, economic security of enterprises, threats, challenges, threat analysis, risks, competitiveness

Альона Загородня, Тетяна Федоренко. «Економічна безпека підприємства: сучасні виклики та загрози». *У статті визначено та проаналізовано поняття економічної безпеки підприємств. Досліджено різні аспекти економічної безпеки підприємства, зокрема, класифікація загроз, що може негативно впливати на його діяльність. Охарактеризовано внутрішні та зовнішні загрози, їхні джерела, характер, ймовірність реалізації та можливі наслідки.*

Розглянуто методи нейтралізації цих загроз, зокрема розглядається можливість створення стійкої системи економічної безпеки на підприємстві та заходи з мінімізації ризиків та загроз. Представлено принципи та етапи реалізації заходів безпеки, що дозволяють підприємству ефективніше протистояти потенційним викликам.

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Ключові слова: економічна безпека, економічна безпека підприємств, загрози, виклики, аналіз загроз, ризики, конкурентоспроможність.

Introduction. The relevance of this study is due to the growing threats to the economic security of enterprises in the modern world, where the development of technologies, increased competition and economic instability create new challenges for business. Businesses are forced to adapt to changing conditions, provide protection against various types of threats, including internal and external, as well as respond to possible risks in a timely manner. The study and analysis of these threats, as well as the development of strategies to neutralize them, are important for maintaining the stability and competitiveness of the enterprise, which makes research in this area extremely relevant.

Analysis of recent research and publications. The theoretical foundations of the concept of economic security of an enterprise were studied by the following scientists: S. Dolynskiy, T. Kuzenko, N. Reznik, L. Shvab, O. Zakharov, as for the issues of threats and risks to the economic security of the enterprise, we can include the following scientists: V. Baidala, V. Loiko, I. Mihus, and others. However, the issues of of economic security of an enterprise are not sufficiently considered and require further research.

The formulation of the goals of the article is to analyze the threats to the economic security of the enterprise and future considerations for developing approaches to their effective neutralization.

Presentation of the main results. The issue of "economic security" has always been of interest to scholars, but they mostly focused on general aspects of security, such as national security, considering economic security as one of the aspects of its formation. It was only in the 1970's that the concept of "economic security" became a separate part of national security. Since then, the term has been actively used around the world, especially in developed countries. The countries of Western Europe, based on a realistic assessment of the international situation, sought to widely use economic methods to ensure their national security [4].

According to T. Kuzenko, the economic security of an enterprise means a state of successful use of the company's resources and capabilities, which makes it possible to counteract external and internal risks, ensures sustainable growth and long-term existence [5].

L. Shvab considers economic security as a state in which an enterprise is protected from the negative impact of the external environment, is able to effectively eliminate emerging threats and adapt to existing conditions that may adversely affect it [9].

Thus, in a broad sense, economic security is a system that ensures the prevention and neutralization of various threats, protects the economic interests of an enterprise and prevents losses exceeding the critical limit.

In his works, researcher O. Zakharov describes a unique approach to the economic security of an enterprise, emphasizing that these are not just individual steps, but a set of interrelated organizational, legal and technical measures aimed at reducing and counteracting real and potential, internal and external risks and threats that can cause significant economic losses, stop or slow down the development of an enterprise [11].

The economic security of an enterprise is influenced by various negative factors and threats, which can be classified according to various criteria. According to the views of scientist I. Migus, a threat is an event that has a negative impact on the efficiency of an enterprise [7].

The threat to the economic security of the enterprise should be considered as some existing conditions, facts that can cause harm, damage, have a negative impact on the development of an economic entity [6].

There are various classifications of threats to the economic security of the enterprise, the most common of them is the division of

threats by the source of occurrence, internal and external.

External threats imply the actions of such persons as:

– third-party firms engaged in industrial espionage;

– organized crime;

– individuals who are hatching fraudulent plans and encroaching on any form of property.

– competing businesses, creditors and investors, and product purchasers;

– former employees of the enterprise who were fired and harbor resentment.

Internal threats to the economic security of the enterprise:

– misconduct of the enterprise's employees themselves, both intentional and unintentional;

– violation of regulations on commercial information and storage of confidential information, violation of access regime, physical protection of the enterprise;

– violation of the rules of using any technical means [10].

Another classification on the types of threats to the economic security of the enterprise by the object of encroachment subdivides into threats:

– personnel (personnel); it is necessary to focus on the implementation of works that promote the efficiency of employees, as well as the development of the intellectual level of personnel.

– technical-technological; the main emphasis should be placed on increasing the level of technical-technological development, focus on international standards, strive to improve competitiveness.

– finance; the main task is to ensure the highest possible level of solvency of the enterprise, liquidity of current assets.

– information; it is necessary to display the incoming information in a timely manner and provide it to all departments of the enterprise to prevent the emergence of threats.

The following classification of threats provides for their division by type of origin into:

1. Accidental (unintentional); such threats are not associated with deliberate actions in relation to the enterprise, they are realized at random moments of time. For example, natural disasters, accidents, breakdowns and failures of equipment, accidental errors of the enterprise personnel.

2. Intentional (deliberate); threats planned in advance, related to human activity, for example, espionage, eavesdropping, theft of confidential information [8].

Threats by the probability of their realization:

– real;

– potential.

Threats by nature of occurrence:

– Political (political situation, change of power, possible reforms in the activities of the state, martial law, imposition of embargo).

– Socio-economic (increase in unemployment, inflation rate, high level of corruption in the country, growth of offenses in the financial and intellectual sector, unstable state of financial policy in the country).

– Criminal (actions of criminal structures towards the enterprise).

– Competitive (behavior of competing enterprises, methods of competitive struggle, factors of monopolization, unfair competition).

Threats by the amount of expected damage:

– catastrophic – continuation of economic activity is impossible, the enterprise is forced to declare bankruptcy.

– significant – the probability of bankruptcy occurs, loss of competitive positions.

– causing difficulties – there is a loss of material resources, the enterprise experiences some difficulties. [3]

Threats by degree of probability:

– improbable – extremely low probability of falling out of the circumstances of the threat to the enterprise;

– unlikely;

– probable – require planning, it is necessary to calculate the significance of damage;

– unavoidable – predictable, their occurrence is obvious and inevitable, must be planned and budgeted.

Threats by their occurrence in time:

– close – predicted and planned in the time interval equal to the period of up to 1 year;

– distant – not planned in the near term. Therefore, cannot be provided for by the current budget, the time period is more than 1 year.

Threats on the basis of their occurrence in space:

– on the territory of the enterprise;

– on the territory of the region;

– on the territory of the state [1].

Neutralization of threats to the economic security of the enterprise is a system of views on the problem of economic security of the enterprise at all stages of production activity, as well as the main principles, directions, stages of implementation of security measures. The very neutralization of threats will cost the enterprise much cheaper than the resolution of the threat that has already occurred. To combat the totality of perceived threats to the activities of the enterprise, it is necessary to create a purposeful process of counteraction, namely, the creation of economic security service at the enterprise, or the transfer of these powers to an external company. It should be noted that it is extremely difficult to protect the enterprise from all types of threats and neutralize their consequences is extremely difficult, because the enterprise carries out its activities in this environment and outside its activities are impossible [2].

Conclusions. Thus, economic security of an enterprise is exposed to numerous threats that can be classified according to various criteria, such as the source of occurrence (internal and external), the object of the attack, the probability of realization, the nature of occurrence, the amount of expected damage, and the time and place of manifestation. Successful management of economic security involves careful monitoring of these threats, planning measures to neutralize them, and creating an effective countermeasure system, such as an enterprise's economic security service. Preventive measures and timely detection of threats are more efficient and cost-effective than overcoming the consequences of already realized threats. This emphasizes the importance of continuously improving the system of protecting the economic security of the enterprise at all levels of its activities.

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STUDY OF THE DYNAMICS OF THE MAIN INDICATORS OF THE ACTIVITY OF TRANSPORT ENTERPRISES IN THE CONDITIONS OF THE INTRODUCTION OF INNOVATION

Iryna Honcharova. "Study of the dynamics of the main indicators of the activity of transport enterprises in the conditions of the introduction of innovation". *In the context of logistics integration, it is important to conduct analytical activities to study the effectiveness of marketing innovations in a timely manner. To form an idea of the effectiveness of marketing activities, it is necessary to study the influence of various factors on the performance indicator, in the case of logistics, this may be the volume of transported goods. The motive for writing the article was to study the capabilities of standard software for analyzing the effectiveness of economic processes in general, and in particular the results of innovative activities. The purpose of the article is to analyze the innovation, namely the integration of the logistics space in a certain region, for four companies in the Northern Black Sea region in order to assess the potential of these companies in the provision of transport services, taking into account the implemented innovation. The study used information provided by transport companies from 2013 to 2022. The choice of the focus of the study in the field of transport support is due to the importance of the quality of transport support for the functioning of the economy, especially in the context of cross-border movement of components and goods, raw materials and finished products. For the optimal study of the innovation efficiency, studies were conducted for two periods, namely from 2013 to 2019, and from 2013 to 2022. The analysis used the tools of mathematical analysis (function derivatives) for polynomial trend equations. It was found that for all four companies that participated in the implementation of the innovation, namely in the formation of an integrated logistics space with the creation of a common rolling stock base and the search for algorithms for the most optimal use of vehicles for cargo transportation, there is a positive dynamics of the total volume of cargo transportation, which indicates the effectiveness of the innovation. The introduction of innovations in logistics is the main condition for increasing the level of transport provision of the economy, which provides opportunities for a more systematic and comprehensive development of the economy. The integration of the logistics space on the example of four companies in the Black Sea region allowed not only to improve the quality of transport services, but also to increase the total profit of the group of companies, which indicates the effectiveness of marketing innovations. The results of the study can be used to replicate the innovation to other transport enterprises both within the region and for other regions. The proposed methodology for analyzing the effectiveness of innovations can be extended to other innovations in various sectors of the economy.*

Keywords: integration, logistics space, transportation, innovation, analysis of innovation, trends

Ірина Гончарова. «Вивчення динаміки основних показників діяльності транспортних підприємств в умовах впровадження інновації». *В умовах інтеграції логістики важливо вчасно проводити аналітичні заходи для вивчення ефективності маркетингових інновацій. Для формування уявлення про ефективність маркетингових заходів необхідно вивчити ефект впливу різних факторів на результативний показник, у випадку логістики це може бути обсяг перевезених*

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вантажів. Метою статті є проведення аналізу інновації, а саме інтеграції логістичного простору в певному регіоні, для чотирьох компаній Північного Причорномор'я, надання оцінки потенційним можливостям цих компаній у сфері надання транспортних послуг з урахуванням реалізованої інновації. Дослідження проводилося з використанням інформації, наданої транспортними компаніями за період з 2013 по 2022 рік. Для аналізу використовувалися інструменти математичного аналізу (похідні функцій) для поліноміальних рівнянь тренду. Встановлено, що для всіх чотирьох фірм, які брали участь у впровадженні інновації, а саме у формуванні інтегрованого логістичного простору з формуванням загальної бази рухомого складу та з формуванням найбільш оптимального використання транспортних засобів для перевезення поза вантажоперевезеннями спостерігається позитивна динаміка загального обсягу вантажоперевезень, що свідчить про ефективність впровадження інновацій. Впровадження інновацій у логістику є основною умовою підвищення рівня транспортного забезпечення економіки. Інтеграція логістичного простору на прикладі чотирьох компаній Чорноморського регіону дозволила не тільки підвищити якість надання транспортних послуг, але й збільшити загальний прибуток групи компаній, що свідчить про ефективність маркетингу інновації. Результати дослідження можуть бути використані як для тиражування інновації на інші транспортні підприємства як в межах регіону, так й для інших регіонів. Запропонована методологія аналізу ефективності інновації може бути поширена на інші інновації у різноманітних галузях економіки.

Ключові слова: інтеграція, логістичний простір, транспортне забезпечення, інновація, аналіз інновації, тренд.

Introduction. In economics, the static state of processes, production lines, and the static level of professional skills of teams leads to unfavorable consequences, since the lack of growth and development immediately affects competitiveness. Innovation processes must accompany all economic processes and not only the content since innovation provides the basis for comprehensive development and acts as a vaccine against crisis phenomena.

Increasing the efficiency of primary and secondary indicators of various economic activities underlies the motivation for innovative marketing. Transport in modern conditions requires constant innovation since most vehicles are used with insufficient efficiency. Since the formation of transportation tariffs initially includes the full cost of cargo transportation, if the vehicle is not fully loaded, the cost of a specific service increases (Honcharova & Metil, 2022). In addition, with a large number of vehicles, each of which is used inefficiently, the potential level of air pollution is higher than if transport is used efficiently. To solve these problems, logistics integration is necessary, which is driven by globalization processes (Karlsson, et al., 2009). Globalization occurs in all areas, however, the integration of logistics is the basis and catalyst of globalization processes. One of the problems in the formation of an integrated logistics space is the difference in the degree of perception of innovation of specific objects that participate in integration processes. Eliminating the imbalance in the degree of perception of innovative actions is necessary for equal participation in the integration processes of its participants. At the level of specific transport enterprises, integration processes in logistics are innovative in nature and require high-quality marketing.

Taking into account the development of digital technologies, it is necessary to take into account the possibilities of prompt and effective control over the process of introducing innovations. Timely analysis of the effectiveness of innovative marketing is important for making management decisions (Pascalau, 2017). There are a variety of evaluation methods used in performance analysis, but for the sake of clarity, this article will focus on the functions that are standard in Microsoft Excel. Considering the marketing of innovations as the basis for improving the economy, they often draw up a plan for marketing activities. Partial analysis of the

implementation of the marketing plan is carried out qualitatively, partly quantitatively. These methods are not interchangeable, they complement each other (Nagaraj, 2021).

The presented research provides answers to the following questions:

- How does the profit trend change when studying selected companies for the periods from 2013 to 2019 and for the period from 2013 to 2022?

- What function determines the growth rate of the profit trend?

- Does innovation in the form of digitalization of cargo transportation affect the profit trend of selected transport companies?

The study examined the profit data of four transport companies operating in the lower Danube region over the past 15-17 years. The time period 2013-2022 was chosen for the study because data for 2023 was not yet available at the time of the study.

Analysis of recent publications on the problem. Research in the field of improving transport provision is very diverse and diverse. Timely delivery of goods, quality of conditions of transportation, storage, loading and unloading, conditions of cargo insurance, factors of responsibility for delivery times, and condition of goods - this is just a small list of issues that are dealt with by various researchers. All of the above and many other issues in the field of delivery of goods often lead researchers to conclusions about the need to develop and implement innovations (Stefan, 2021).

. Innovation does not arise by itself; it is a planned process, which is the result of analytical activities to find problem areas in the functioning of certain processes.

Since to obtain the maximum economic effect at the lowest possible cost, the quality of transport services is of great importance, the study of modern trends in logistics is becoming increasingly important and attracts the attention of many researchers. Integration in logistics is an opportunity to take the industry to a qualitatively new level. Integration processes in the field of logistics allow us to consider from a new perspective such fundamentals of market relations as healthy competition and government intervention (Pfohl, 2022). If we consider the fact of competition, then under conditions of integration, competitive advantages may change their composition, for example, in conditions of the desire to limit the carbon footprint, an environmental factor will be added to the usual components of competition. State intervention in the context of integration can be demonstrated by tutoring in the organization of supply chains, stimulation of mutually beneficial cooperation, and the creation of business incubators for the formation of integration logistics relationships (Kunert, 2018).

Modern specialized literature examines various ways to analyze the effectiveness of innovation in general and in particular the innovation marketing system (Aram, et al., 2019). The authors describe the processes associated with conducting analytical activities in different ways, but upon detailed study, it should be noted that analytical activities differ in structure, but have common methodological foundations (Fragerberg, et al., 2006). In particular, most authors view qualitative analysis as the basis for determining quantitative analytical activities (Honcharova, et al., 2023).

When studying innovations in transport in quantitative terms, the main ones are the cost volumes of services provided for the transportation of goods (in ton-kilometers), the percentage of vehicle load, and company profit. However, it is very rare to find conditions for considering such quantitative indicators as the amount of harmful emissions from transport into the atmosphere, the efficiency of using labor resources, and assessing the quality and timeliness of cargo delivery from consumers (Pfohl, 2022).

Carrying out innovative methods in transport in the context of logistics integration is aimed at improving the quality of transport services provided. To obtain analytical information on the effectiveness of innovation marketing, criteria and

performance indicators are needed, which will be considered when making further management decisions (Brem, et al., 2019).

Allocation of previously unsolved parts of the general problem. Innovation certainly has an impact on the bottom line of the companies in which it is implemented. The formulation of the results of innovation activity has been studied and considered in various studies and the results of analysis of the work of specific enterprises after a number of events. To assess the potential positive impact of innovation on the final result of transport companies, an accessible and convenient assessment tool is needed that can assess the potential benefits of innovation, regardless of the amount of money spent on introducing innovation. Since innovative activity in the field of transport management is associated with a number of problems, most of which are related to the provision of transport services across the territories of different states, a mechanism for potential assessment of the effectiveness of innovation is necessary not only as an economic tool but also to preserve the image component in working with foreign partners.

Formulation of research objectives (problem statement). The main goal of this study was to show the need for a preliminary analysis of planned innovations. The research involved solving several problems. The first goal was to obtain a tool for assessing the impact of innovations, accessible through standard software products. The second task was to analyze a specific innovation, namely the innovation of creating an integrated logistics space in the Lower Danube region. The third objective of the study was to establish the consequences of the innovation for the four transport companies involved in the innovation.

Materials and Methods. To determine the interdependence of factors that describe the effectiveness of innovative activities carried out during the marketing of innovations in the context of logistics integration, we will consider the possibilities of using standard Microsoft Excel tools to obtain analytical information (Machado & Davim, 2022).

To determine the degree of relationship between the cost volume and the percentage of transport load, between the percentage of transport load and the company's profit, and between the cost volume and the company's profit for the period chosen for the study, we will use the correlation coefficient (Trachenko, et al., 2021). Since the correlation coefficient shows the degree of relationship between the indicators (strong for a value close to one, weak for a value of about 0.5, and no relationship for a value close to zero), and the nature of the relationship (direct for a positive value and inverse for a negative value).

By studying the correlation between various quantities, you can select pairs with the strongest dependence. Selecting such pairs for further research allows us to obtain information about the effectiveness of innovation marketing by comparing the trend line of a certain indicator for the base period of the study with the trend line for the entire period, starting from the stage before the innovation is introduced, ending with the period in which the consequences after the innovation are introduced (Stefan, 2021). By comparing trend lines of the same format using differential calculus methods, we obtain information about the nature of the trend in the pre-innovation period and the full period under study.

An outline of the main results and their justification. Description of the research object. As an example, consider the work of four transport companies: Bessarabia-trans, Diamant, Euro-Moving, and ITL. All selected companies operate in the lower Danube region in the freight transport sector. Companies are united by common innovation. The essence of the innovation is to create a common logistics system and customer service. This innovation has been in operation since 2020. As part of the study, we will analyze the effectiveness of marketing innovation in the conditions of integration of the logistics space.

As an object of study, we will consider four companies that are engaged in the delivery of small and medium-sized industrial cargo in one area. Companies have vehicles similar in composition, but different in number. Before the introduction of innovation, all companies did not have electronic communication services with clients.

The essence of innovation. Marketing the innovation consisted of building an algorithm for creating a unified customer support service. The main obstacle to the implementation of this innovation was the fear of a decrease in the flow of customers in some companies due to an increase in others, however, complete transparency in the formation of routes based on customer orders allowed the owners of all four companies to be convinced of the high potential of this innovation, the implementation of which began in 2020. The innovation implementation technology is as follows. A logistics center was opened based on the Bessarabia-trans company, the work of which is financed by all participating companies in the amount of 0.05% of the cost of the order received through this center, which is an example of the integration of the logistics space. Work with clients is carried out by center specialists. The formation of orders and information on settlement transactions with clients is available in real-time for all participants in the integration project.

Determination of a pair of the most significant indicators. Let's consider the correlation between such indicators as the value of cargo delivered, the percentage of vehicle load, and company profits for the period from 2013 to 2022. Table 1 presents the results of calculating the correlation coefficient for pairs of indicators for each company separately.

Table 1 – Results of the study of correlation between pairs of indicators

Companies/indicator pairs	Cargo delivered - percentage of vehicle load	Percentage of vehicle load - company profits	Cargo delivered – company profits
Bessarabia-trans	0.923041	0.949211	0.91698
Diamant	0.900326	0.927397	0.849807
Euro-Moving	0.807751	0.942454	0.853865
ITL	0.929461	0.93144	0.869445

Source: compiled by the author based on data provided by companies

As can be seen from Table 1, the selected indicators have a strong direct relationship, which is characterized by the resulting correlation coefficients ranging from 0.8 to 0.95. Consequently, the selected indicators can be used to conduct a trade analysis to obtain information about the effectiveness of the innovation being introduced, which will be carried out for each company separately.

Research of vehicle load percentage. Let us show an example of a study using the example of the Bessarabia-trans company. Figures 1 and 2 show the results of constructing trends for the percentage of vehicle load in a given company for the periods from 2013 to 2019 and for the period from 2013 to 2022, respectively.

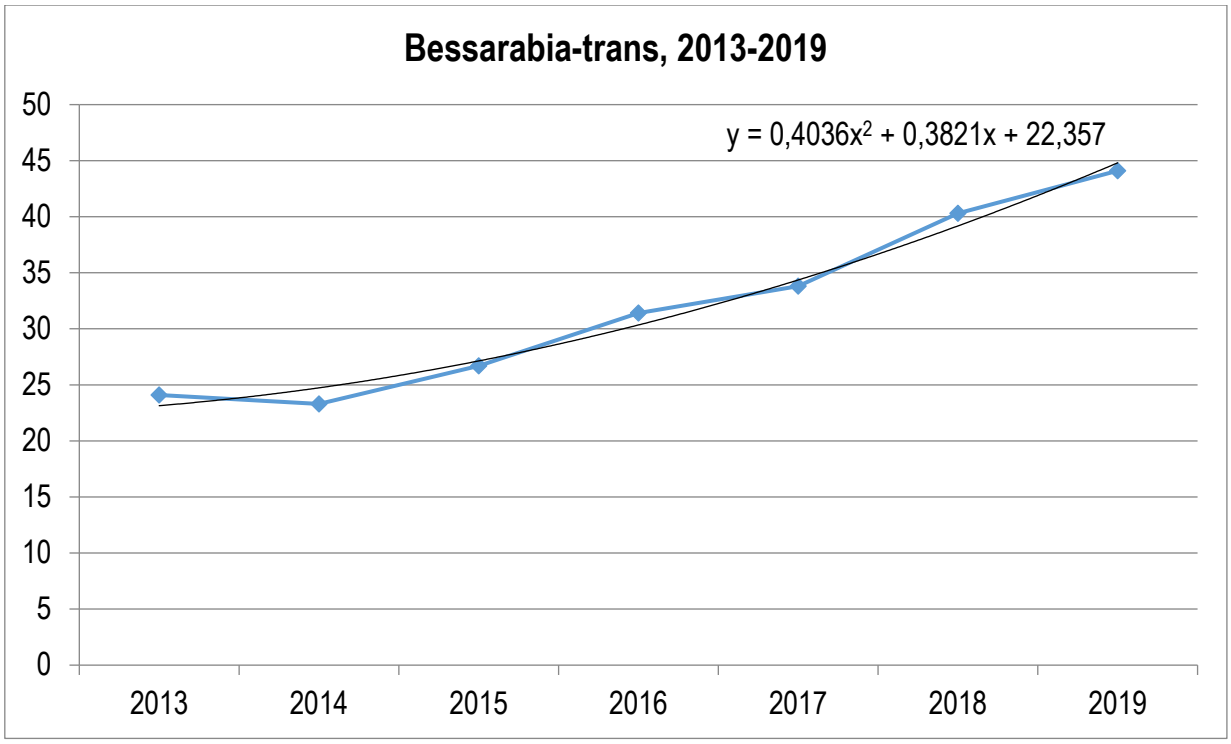

Figure 1 – Percentage of vehicle load, 2013-2019
Source: compiled by the author based on data provided by Bessarabia-trans

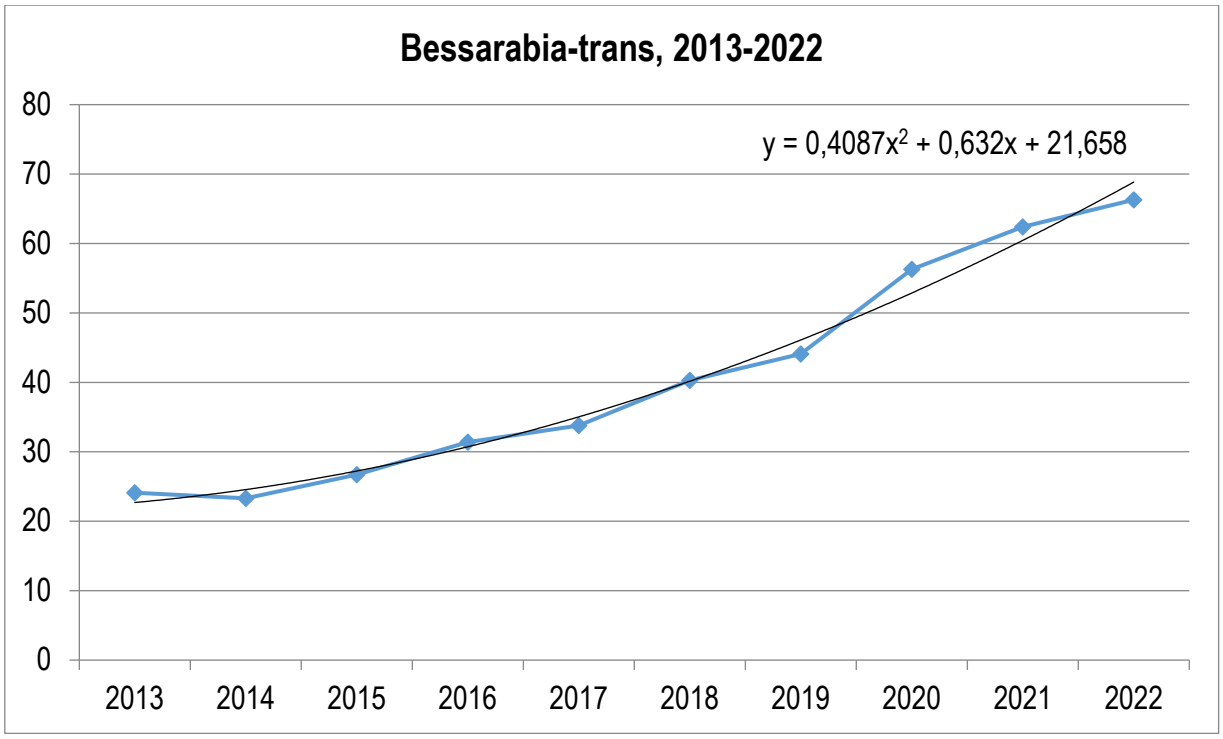

Figure 2 – Percentage of vehicle load, 2013-2022
Source: compiled by the author based on data provided by Bessarabia-trans

Using Microsoft Excel tools, the following trend lines were obtained: (1) for period 2013-2019, and (2) for period 2013-2022.

$$y_1 = 0.4036x^2 + 0.3821x + 22.357 \quad (1)$$

$$y_2 = 0.4087x^2 + 0.632x + 21.658 \quad (2)$$

To compare the nature of trends in changes in the percentage of vehicle loads before and after the start of the introduction of innovation in selected areas, we will find the derivative of each of the obtained functions. After differentiation we obtain (3) and (4).

$$\frac{dy_1}{dx} = 0.8072x + 0.3821 \quad (3)$$

$$\frac{dy_2}{dx} = 0.8154x + 0.632 \quad (4)$$

Since the nature of changes in trends is described by increasing linear functions, it is possible to compare the rate of increase of the characteristic using the angular coefficients of these straight lines. Based on the results, we see that after the introduction of the innovation, the trend in the percentage of vehicle load in the Bessarabia-trans company increased.

Research of enterprise profits. When considering the profitability indicator of the Bessarabia-Trans company, using Microsoft Excel tools in a similar manner to previous actions, we obtain the results that are shown in Figure 3 for the period from 2013 to 2019 and in Figure 4 for the period from 2013 to 2022.

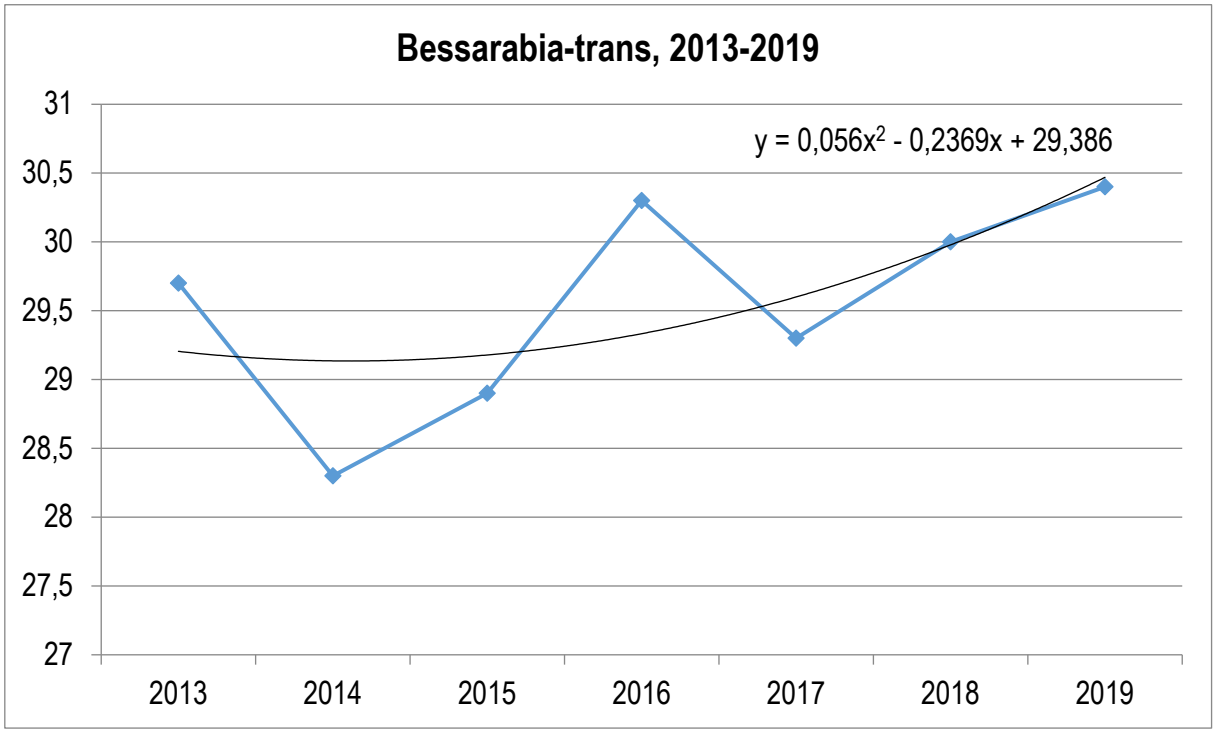

Figure 3 – Profit, 2013-2019
Source: compiled by the author based on data provided by Bessarabia-trans

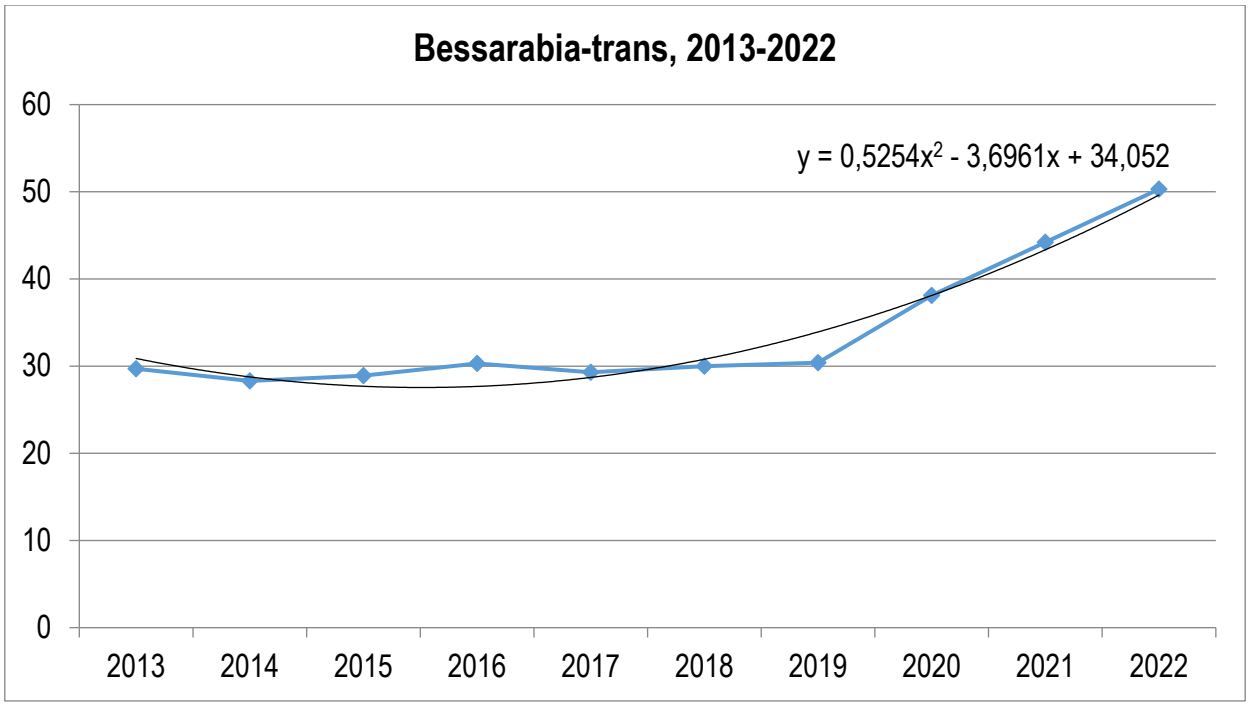

Figure 4 – Profit, 2013-2022

Source: compiled by the author based on data provided by Bessarabia-trans

Let's look at the trend lines obtained using Microsoft Excel for enterprise profits for the period 2013-2019 (5) and the period 2013-2022 (6).

$$y_3 = 0.056x^2 - 0.2369x + 29.386 \quad (5)$$

$$y_4 = 0.5254x^2 - 3.6961x + 34.052 \quad (6)$$

When differentiating the obtained functions that describe the trend in the profit of the Bessarabia-trans company, we obtain the following increasing linear functions (7) and (8).

$$\frac{dy_3}{dx} = 0.112x - 0.2369 \quad (7)$$

$$\frac{dy_4}{dx} = 1.0508x - 3.6961 \quad (8)$$

Reasoning similarly, for the remaining companies we will obtain polynomial trends and find their derivatives. The results of the study are recorded in Table 2.

Table 2 – Research results

Company	Indicator	Period	Polynomial trend	Derivate of trend
1	*2*	*3*	*4*	*5*
Diamant	. Percentage of vehicle load	2013-2019	$0.1345x^2 + 0.5845x + 65.414$	$0.269x + 1.169$
		2013-2022	$0.1784x^2 + 0.2793x + 65.805$	$0.3568x + 0.2793$
	Profit	2013-2019	$0.0476x^2 + 1.519x + 8.1$	$0.0952x + 1.519$
		2013-2022	$0.0549x^2 + 1.4522x + 8.2033$	$0.1098x + 1.4522$
Euro-Moving	. Percentage of vehicle load	2013-2019	$0.6048x^2 - 0.6667x + 35.771$	$1.2096x - 0.6667$
		2013-2022	$0.6264x^2 - 0.3866x + 34.868$	$1.2528x - 0.3866$
	Profit	2013-2019	$0.4226x^2 - 1.7131x + 20.429$	$0.8452x - 1.7131$
		2013-2022	$0.4534x^2 - 1.7499x + 20.248$	$0.9068x - 1.7499$
ITL	. Percentage of vehicle load	2013-2019	$0.0488x^2 + 4.156x + 53.814$	$0.0976x + 4.156$
		2013-2022	$0.1629x^2 + 5.7898x + 51.517$	$0.3258x + 5.7898$
	Profit	2013-2019	$-0.0345x^2 + 0.6726x + 4$	$-0.069x + 0.6726$
		2013-2022	$0.0197x^2 + 0.2524x + 4.5933$	$0.0394x + 0.2524$

Source: compiled by the author based on data provided by companies

If we analyze the results obtained in column (5) of the table and the results described in formulas (7) and (8), then a general upward trend in the obtained polynomial trend equations is determined both for the period from 2013 to 2019 and for the period from 2013 to 2022, which indicates a generally positive trend as a result of the use of innovative means, the marketing effectiveness of which is considered in this study.

Conclusions and perspectives of further research. Judging by the change in the angular coefficients of trend polynomials for individual indicators for the periods from 2013 to 2019 and from 2013 to 2022, we see that positive dynamics are typical for all companies. This means that marketing innovations in the field of logistics space integration for all four firms included in this experiment lead to an increase in the vehicle load percentage, that is, they increase the efficiency of transport use. Thus, for the Bessarabia-trans company, the percentage of vehicle loading for the period from 2019 to 2022 increased by 22.2%, for the Diamant company by 8.9%, for the Euro-Moving company by 12.5%, and for the ILT company by 7.8%. %. The situation is similar to the other indicators that were studied, that is, in profit. As shown in Table 2, when considering the dynamics of company profits over a longer period, that is, taking into account the period of integration activities using digitalization cross-sections, all trend lines of company profits have a derivative, which is an increasing function. That is, when the period of innovation is included in the study, positive results in the dynamics of company profit growth are clearly visible.

The profit of the group of companies as a whole increased by 53.5%. Such a significant increase in profits is due to successful marketing of the innovation. Therefore, this example of logistics integration can be considered an effective innovation. Since the experience of creating a single logistics center for four companies is positive, a scenario for the development of innovations with the involvement of other similar companies is possible.

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ADAPTATION OF LOGISTICS MANAGERS' COMPETENCY MODELS TO INDUSTRY 5.0 CHALLENGES

Mariya Hryhorak, Marina Pichugina. "Adaptation of logistics managers' competency models to industry 5.0 challenges". *Radical geopolitical and geoeconomic transformations in the global economy are disrupting established economic ties and traditional routes of global commodity movement. Rapid technological changes, accelerated development of e-commerce, omnichannel strategies, and the sharing economy have contributed to increased demand for automation, robotization, and digitalization of logistics activities and supply chain management. These factors prompt the renewal and adaptation of the competencies set for logistics managers and, consequently, academic educational programs. The aim of the conducted research was to identify the impact of Industry 5.0 on the formation of the logistics personnel competency system, and to develop a new competency model considering rapid changes in technology, market conditions, consumer sentiments, and the regulatory environment. The research methodology combines theoretical analysis (theoretical generalization, analysis and synthesis, comparison, and grouping) with empirical research. As a result, existing and future trends in the logistics industry development were summarized, a comparative analysis of the competencies of logistics managers and engineers was conducted, and a tendency for their convergence under the influence of the transition from Industry 4.0 to 5.0 was identified. The developed comprehensive competency model for logistics managers in the context of Industry 5.0 allowed for improving the content and structure of the "Logistics" educational program at the National Technical University of Ukraine, determining the ratio between general and professional skills, the set of necessary tools and technologies required for developing and implementing logistics solutions, stimulating students to improve their knowledge, skills, and abilities, as well as orienting them towards effective professional activity in the future.*

Future research is reasonable to focus on evaluating new technological courses' effectiveness, developing interdisciplinary teaching methods, integrating practical experience, incorporating sustainability and social responsibility, and creating innovative assessment techniques to ensure curricula meet evolving labor market demands and prepare students for real-world challenges and new Industry 5.0 requirements.

***Keywords**:* Geopolitical transformations, Geo-economic changes, Logistics, Global economic relations, Industry 5.0, Digitalization, Robotization, Supply chains, Competencies of logistics managers, E-commerce, Competency model, Technological changes, Labor market, Sustainable development, Innovative assessment methods.

Марія Григорак, Марина Пічугіна. «Вивчення динаміки основних показників діяльності транспортних підприємств в умовах впровадження інновації». *Кардинальні геополітичні та геоекономічні трансформації, що відбуваються в глобальній економіці, руйнують усталені господарські зв'язки та традиційні маршрути глобального товарного руху. Швидкі технологічні зміни, прискорений розвиток електронної комерції, омніканальних стратегій та економіки спільного користування сприяли зростанню попиту на автоматизацію, роботизацію та цифровизацію логістичної діяльності та управління ланцюгами постачання. Ці фактори спонукають до оновлення та адаптації сукупності компетенцій менеджерів з логістики і, відповідно, академічних освітніх програм.*

Метою проведенного дослідження було виявлення впливу Індустрії 5.0 на формування системи компетенцій логістичного персоналу, розробка нової моделі компетентності з урахуванням швидких змін в технологіях, ринкових умовах, спочивчих настроях та регуляторному середовищі. Було розроблено методологію дослідження, яка combining theoretical analysis (theoretical generalization, analysis and synthesis, comparison, and grouping) with empirical research. В результаті було узагальнено існуючі та майбутні тренди розвитку логістичної галузі, проведено порівняльний аналіз сукупності компетенцій менеджерів та інженерів з логістики і виявлено тенденцію їх зближення під впливом переходу від індустрії 4.0 до 5.0.

Розроблена комплексна модель компетентності менеджерів з логістики в умовах індустрії 5.0 дозволила удосконалити зміст і структуру освітньої програми «Логістика» Національного технічного університету України, визначити співвідношення між загальними та професійними навичками, сукупність необхідних інструментів та технологій, необхідних для розробки і впровадження логістичних рішень, стимулювати студентів для самовдосконалення своїх знань, вмінь та здатностей, а також орієнтувати їх ефективну професійну діяльність в майбутньому.

Майбутні дослідження доцільно зосередити на оцінці ефективності нових технологічних курсів, розробці міждисциплінарних методів навчання, інтеграції практичного досвіду, включенні сталого розвитку та соціальної відповідальності та створенні інноваційних методів оцінювання, щоб забезпечити відповідність навчальних програм мінливим вимогам ринку праці та підготувати студентів до реальних викликів і нових вимог Industry 5.0.

Ключові слова: Геополітичні трансформації, Геоекономічні зміни, Логістика, Глобальні господарські зв'язки, Індустрія 5.0, Цифровізація, Роботизація, Ланцюги постачання, Компетенції менеджерів з логістики, Електронна комерція, Компетентнісна модель, Технологічні зміни, Ринок праці, Сталий розвиток, Інноваційні методи оцінювання

Introduction. The world is undergoing a profound geopolitical and economic transformation, with far-reaching consequences. International scientific and analytical centers, including IBM Institute for Business Value [1], «Think 30 Conference» [2], Global Solutions Initiative [3], and others, strive to understand the essence of these profound changes, seeking solutions for a "multi-crisis" era and propose new approaches and mechanisms to ensure sustainable economic development. The ongoing geopolitical tensions, including the confrontation between the West and the South, military conflicts, and trade wars, are disrupting global supply chains and logistics, destroying established economic ties and routes of global commodity movement. International supply chain schemes are

changing due to the cessation of links located in rival countries, reshoring, or friend-shoring or near-shoring. As the world economy fluctuates between the interdependence of global supply chains, the surge in domestic production and protectionism, logistics companies continue to provide flexibility and commodity movement efficiency, designing supply networks to meet real-time demand.

Ukraine is currently caught in the crossfire of these tectonic shifts, which creates both additional threats and opportunities for the country to become home to many businesses. Ukrainian logistics as a whole has adapted to the new realities and is successfully functioning under martial law conditions. The industry is recovering and integrating into the European and global transport and logistics network. Domestic agro-industrial holdings, trade and production companies, and developers are making significant contributions to the development of Ukrainian logistics. Despite difficult circumstances, new transshipment complexes are being built in Ukraine, and warehouse hubs and vehicle fleets are being modernized. Moreover, some companies are creating their own fleets, investing billions of hryvnias in development, and, given this, need to establish effective public-private partnerships and expect further European integration reforms. The movement towards European integration activates shifts in industry, in particular, stimulates the production of more technological products, the implementation of joint production and innovation projects in promising sectors of the economy, and accelerated movement from Industry 4.0 to Industry 5.0.

One of the key factors in making decisions about the possibilities of relocating production to Ukraine is the quality of human capital and competence in logistics and supply chain management. Currently, there are many business programs, seminars, and training sessions that allow the development of specific professional and general competencies of logistics specialists. A special role in training personnel for the logistics sector belongs to academic education, which, on the one hand, must respond to labor market demands, and on the other hand, be proactive, take into account global and national trends in industry development, and form competencies for the future. To train effective logistics managers, educational programs must adopt a competency-based approach. This means designing curricula that align with the specific skills needed by the industry, considering factors such as labor market demands, societal expectations, and the evolving landscape of logistics services. It is very important to take into account the speed of changes occurring in the logistics business environment and adapt the content and quality of specialist training in accordance with these changes and trends.

It is worth noting that the study of the transformation of logistics managers' competencies in the face of modern challenges is relevant for several reasons:

Firstly, modern technologies such as automation and robotics, artificial intelligence, big data, the Internet of Things, and others are radically changing logistics processes. Logistics managers must possess new technical knowledge and skills to effectively use these technologies in their work.

Secondly, rise of online shopping, the integration of online and offline channels, and the sharing economy are transforming the way businesses operate. This requires logistics managers to adopt new approaches to supply chain management and optimization of logistics operations.

Thirdly, business globalization requires logistics managers to understand international markets, legislation, and cultural aspects. This requires knowledge of international logistics, risk management, and global supply chains.

Fourthly, in the context of rapid development of scientific and technological progress, technological structures, and the global transition from Industry 4.0 to Industry 5.0, logistics is a driver of economic growth and a connecting link for various industries,

providing services that support core production and commercial activities, and can also contribute to increasing market share and gaining competitive advantage. The logistics industry in recent years can be characterized by three elements: growing customer requirements and expectations, sustainable development with the application of environmental solutions in logistics processes, and the use of innovative technologies that support the organization and execution of tasks.

Fifthly, growing attention to environmental responsibility and sustainable development requires logistics managers to have new competencies in green logistics, waste management, and carbon footprint reduction. The importance of social responsibility and ethics in logistics operations is also increasing.

The above indicates the chosen research direction.

Literature Review. Leading scientists from various countries constantly pay attention to the study of the structure and necessary changes in skills and competencies in such a rapidly changing sector as logistics and supply chain management. Different authors at different times have identified different competencies as the most important in logistics and supply chain management. Back in 1982, Richard Boyatzis published the book "The Competent Manager: A Model for Effective Performance," which became the foundation for further development of competency models [4], including in logistics. Murphy and Poist substantiated that a successful logistics manager must possess a comprehensive skill set encompassing three primary areas: business, logistics, and management, known as the "BLM" framework [5]. Many scholars use the competency model for standard talent analysis in the logistics industry and pay great attention to general rather than special competencies.

For the purposes of our research, publications by Gammelgaard & Larson (2001) [6], Mangan i Christopher (2005) [7], Kisperska-Moroń (2010) [8], Derwik & Hellstrom (2017) [9], are important, as they summarized the set of necessary individual and professional competencies in the context of logistics and supply chain management.

The competence sets for logistics managers can vary significantly depending on the country due to regulatory requirements, level of technological development, market conditions, cultural characteristics, economic context, educational standards, and the globalization. These factors shape the specific skills and knowledge required for the successful logistics processes management in a specific context. Given these conditions, the results of studies on regional and national logistics labor market and, accordingly, the importance of various competencies for successful career growth conducted in Slovenia [10], Serbia [11], China [12], and Malaysia [13] were useful for us. In particular, researchers from China proposed a model of talent competency in logistics, including parameters of potential and personal traits such as team spirit, responsibility, and the ability to collect and analyze information.

Numerous interviews with business representatives confirmed that logistics specialists should possess cross-functional understanding of different business areas, strategic decision-making skills, communication, leadership and intercultural communication skills, as well as well-developed analytical and IT skills to manage the various tasks they face daily [14].

Anthony Clarke [15] identified 12 core logistics skills for an effective supply chain manager: collaboration and communication, financial management, inventory management, strategic planning, leadership and management, transportation management, problem-solving, warehousing and storage, supplier management, risk management, quality control, and data analysis. At the same time, skills needed for managing logistics processes and supply chains in the next 3-5 years include innovation implementation, big data analysis, crisis management, uncertainty

management, intercultural intelligence, management of global hybrid teams, human-centricity, and situational self-awareness.

According to Kotzab et al. (2018) [16], four types of competencies were identified:

- Professional competencies that contain knowledge and skills specific to the profession or position;
- Methodological competencies - the ability to apply methods for more efficient and effective work results, including information processing and systematization, problem-solving, solution creation, and decision-making;
- Social competencies refer to soft communication skills that include competencies such as group and relationship-oriented behavior, communicative behavior, cooperative behavior, perseverance, and the ability to resolve conflicts;
- Personal competencies related to the development of one's own personality within the work role, including the ability for self-reflection and self-organization to maintain motivation and desire to work.

Remarkably, while academic literature often emphasizes social skills, job advertisements reflect a greater demand for cognitive and meta-competencies, indicating a discrepancy between theoretical and practical requirements for logistics managers. For instance, Katiniene et al. (2021) identified working with people as the most important social competence in logistics and supply chain management, as this field is service-oriented [17]. Sapper et al. (2021) rated learning readiness as the most important personal competence, as they believe it is crucial for the dynamic field of logistics services, and interdisciplinarity will become the most significant methodological competence in the future [18]. Derwik, Hellström, Karlsson [14] also noted that the competencies required for logistics and supply chain management are sifting towards a combination of managerial, general, and behavioral competencies.

On the other hand, a survey of supply chain specialists, mainly in developed countries, showed that it is difficult to university graduates possess the set of practice skills. This is evidenced by the analytical reviews results of international associations such as Association for Supply Chain Management (ASCM), CILT (Chartered Institute of Logistics and Transport), CSCMP (Council of Supply Chain Management Professionals), European Logistics Association (ELA), FIATA (International Federation of Freight Forwarders Associations), and others.

One of the most systematic and comprehensive studies was conducted by Kuehne Logistic University (KLU), commissioned by the World Bank among the Logistics Performance Index countries, and focused on skills and competencies, hiring, and retention of logistics personnel worldwide [19]. This was the first attempt at a comparative analysis of skills and competencies in logistics worldwide, based on online surveys of logistics companies, the global Logistics Performance Index (LPI) results, as well as results of case studies, particularly in the freight transport sector. The project compared logistics skills and learning conditions in emerging markets in Africa, South America, and Asia with those in more developed countries in Europe and North America. Internal studies in some countries, such as China, India, the United States, the United Kingdom, Vietnam, and the Republic of Korea, showed that businesses have difficulties hiring personnel with the necessary skills in logistics and supply chain management. The development of logistics, particularly IT, requires new competencies that the existing workforce lacks. They argued that the problem is twofold. On one hand, positions are often simply vacant because there are insufficient personnel with appropriate skills and qualifications in the labor market. On the other hand, this skills deficit in the existing logistics workforce arises because a significant portion of personnel is not keeping up with technical innovations, operational procedures, and

changing market dynamics. The authors also note that most logistics-related activities are outsourced to the 3PL sector, where large 3PL companies with multinational coverage must "tune" their workforce according to the logistics characteristics of the countries in which they operate.

The need for digital skills was accelerated by the global Covid-19 pandemic, as many businesses were forced to use remote forms of employment and change supply chain strategies to become more flexible, resilient, and transparent (McKinsey, 2020-2022) [20]. The transformation of logistics managers' competencies in the digital era is characterized by the integration of traditional management skills with digital competencies, cognitive abilities, and understanding of environmental issues. The literature argues that these competencies are crucial for navigating the complexity of modern supply chains and achieving sustainable competitiveness. That is why recent studies on the competence of logistics and supply chain managers are associated with changes in technological paradigms, Industry 4.0 and 5.0. In particular, Wahab, Rajendran, and Yeap (2021) emphasized the need for retraining and requalification of logistics personnel in the 4th industrial revolution [21], and the article [22] emphasized the need for analytical skills and the ability to work with large database. Recent studies by research groups have combined Industry 5.0 with supply chain management [23, 24]. In this context, the research of authors who highlighted the importance of digital competencies as a significant catalyst for a sustainable transition of business models to Industry 5.0 is of scientific and practical interest, as well as those that concluded that developing economies should play an active role in shaping the future by creating social stability promoting policies, resource conservation, and achievement of climate goals, ensuring more productive manufacturing processes with less waste and energy consumption.

Pacher, Woschank and Zunk (2023) argue that Industry 5.0 and the associated transformation into Society 5.0 require a complete restructuring of the tomorrow's engineers' skills [25]. To this end, the authors created a competency profile for engineering education in industrial logistics and proposed approaches to assessing and measuring competencies. And Nayeri et al. developed a decision support system for studying the adaptive supply chain 5.0 based on Industry 5.0 in the healthcare system, so the study presents an adaptive supply chain 5.0 [26].

It should be noted that the problem of forming and developing the competence of logistics specialists also attracts the attention of Ukrainian scientists. Among recent publications, the following results are worth noting: articles [27, 28, 29] prove the relevance of information and communication skills for future managers, the work [30] proposes a "T9 Model" of competence for logistics managers, combining general management competencies, problem-solving competencies, interpersonal, and functional logistics competencies; publications [31, 32] focus on the processes of transforming professional competencies of logisticians under the influence of pandemic and military restrictions, as well as determine the impact of digital technologies in supply chain management on the formation of professional competence, trends in their development in the conditions of a recovering economy [33].

Thus, the literature review showed, on the one hand, the relevance of research on the transformation of logistics managers' competencies in a changing business environment, and on the other hand, the gaps and discrepancies between the competencies demanded by the labor market and the existing university educational programs, the lack of a comprehensive analysis of the impact of Industry 5.0 on the formation of competence of logistics and SC specialists. This conclusion prompted us to research this topic in more depth.

The aim of the research is to identify and analyze trends in the development of the logistics industry, summarize factors

influencing the set of logistics managers competencies, develop a competency model taking into account rapid changes in logistics services markets and Industry 5.0 technologies, as well as develop recommendations for adapting educational programs to new conditions.

Research Methodology. This study aimed to investigate how the competencies of logistics managers are evolving in the context of Industry 5.0. To achieve this, we employed a mixed-methods approach, combining theoretical analysis (theoretical generalization, analysis and synthesis, comparison, and grouping) with empirical research. The first stage involved a comprehensive analysis of existing scientific literature, and reports on the Industry 5.0 and its impact on the logistics managers competencies. This allowed for the identification of main trends, modern theoretical approaches, and practical solutions. To illustrate real examples of competency transformation in various companies, a detailed analysis of specific cases was conducted, primarily focusing on leaders in the logistics services market who have successfully adapted their business models to the new conditions of Industry 5.0. The second stage was dedicated to developing a new model of competency for logistics managers in the context of Industry 5.0 and ways to implement it at the National Technical University of Ukraine. The research results were interpreted considering the theoretical context of Industry 5.0 and the identified changes in the logistics managers competencies. This methodology allowed for a comprehensive approach to studying the transformation of logistics managers' competencies in the context of Industry 5.0, combining theoretical and practical aspects for a deep understanding and practical application of the results. It enables the construction of a new model of academic logistics education, taking into account the latest trends and prospects for industry development under the influence of business digitalization and rapid changes in the market business environment.

Research Results. Let's first consider the changes that have occurred in the global logistics industry over the past two years. It should be noted immediately that the key transformations in logistics activities are associated with the growing pace of digitalization in managing global and regional supply chains, active implementation of modern digital technologies in the activities of logistics operators, ensuring continuity and the need for rapid adaptation to changing business conditions. It can be unequivocally stated that technologies are making a real revolution in logistics and supply chain management, as they automate processes, improve visibility and transparency of all stages of product movement, and allow for real-time data analysis and tracking.

Similar changes are occurring in the logistics industry of Ukraine, but they have their own peculiarities related to military actions. According to the results of the industry study "Infrastructure Index 2023" [34], conducted by the European Business Association together with law firms Arzinger and Sayenko Kharenko, in 2023, 79% of surveyed logistics companies did not stop their activities and continue to operate, 13% stopped work but have partially resumed, and 6% stopped work but have fully resumed. The work of 2% of companies is currently suspended. According to official statistics, 9 out of 10 largest logistics companies specializing in transportation and cargo have significantly increased their activity (according to YouControl data).

According to the State Statistics Service, from March to December 2023, 282.4 million tons of cargo were transported by all types of transport, which is 22% more than in the same period of 2022. In 2024, the positive "cargo" trend continues. This is clearly demonstrated by the results of the main segment of cargo transportation - railways, which traditionally accounts for about half of the total volume of cargo transportation in Ukraine. In the first

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half of this year, Ukrzaliznytsia increased volumes by 90 million tons of cargo, which is 28% more than in the same period of 2023. At the same time, export transportations increased by almost 59% [35].

Table 1 summarizes the global factors influencing the transformation of the world market of logistics services, as well as identifies the peculiarities of these factors' impact on the logistics industry of Ukraine.

Table 1. The impact of global factors on the transformation of the logistics industry in Ukraine

Factors of Influence	Global Context of Changes	Ukrainian Context, Impact on Ukraine
1	2	3
Changes in supply geography and logistic flows reorientation	Closure or restriction of traditional transport flows due to military actions in certain regions (Middle East, Ukraine, Red Sea crisis, etc.). Economic sanctions, trade restrictions, customs procedures, and tariff barriers affect the accessibility of raw material markets and supplier selection.	1. Due to the war, many traditional global logistic routes became inaccessible for Ukrainian importers and exporters, forcing companies to reorient to new markets, particularly European, and seek alternative routes for export and import (using Danube River ports, opening new railway and road crossings to the EU, and road routes through Poland, Romania, and other neighboring countries). 2. Business relocation – moving production from Eastern and Southern Ukraine to the west, as well as to neighboring European countries, which changed the geography of both internal and international cargo flows. 3. Increasing role of domestic carriers in the Ukrainian market, growth of their market share, as foreign carriers are not interested in traveling to frontline areas like Kharkiv or Zaporizhzhia under war conditions. 4. Active use of combined cargo transportation schemes involving rail and river transport with access to EU ports and subsequent delivery of goods directly via European road and rail routes.
Growth of online trade	E-commerce is the new norm in the global logistics market. To synchronize the shopping ecosystem, the supply chain needs to provide a seamless omnichannel sales experience. Customers want fast and flexible transportation of goods combined with full control over the process chain.	Ukrainian logistics companies also strive to integrate various logistics services – warehousing, transportation, and customs – into a single platform, allowing operators more efficient supply chain management. The last-mile delivery segment is actively developing. The number of courier companies and express delivery enterprises is growing. Construction of fulfillment centers is resuming, and the volume of fulfillment services by logistics companies is increasing. Most large retail chains have transitioned to combining online and offline sales channels, stimulating demand for multichannel **logistics.**
Changes in consumer preferences	Individualization and personalization of customer service necessitate flexible and adapted logistics solutions. Requirements for speed and accuracy of order fulfillment are increasing, along with growing demand for express delivery.	Emergence of new types of logistics services, new market segments, diversification of logistics service providers' activities. Active expansion of Ukrainian postal and courier companies into markets of other countries ("Nova Poshta" currently has offices in 18 countries worldwide and delivers goods to 213 countries).

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Continue of table 1

1	2	3
Digitalization and innovation	Automation of logistics processes, use of GPS systems for monitoring vehicle and cargo movement, Internet of Things technologies, artificial intelligence, blockchain, which increases transparency and efficiency of supply chain management.	Leading logistics companies are actively implementing automated warehouse management systems (WMS), transport management systems (TMS), and supply chain management systems (SCM). The relevance of logistics process automation in Ukraine is intensified by the shortage of personnel in the industry and becomes key to the survival of logistics companies. In Ukraine, there is growing demand for digital solutions such as online platforms for cargo transportation management, drones for monitoring and delivery, IoT technologies, and blockchain for ensuring supply chain transparency. This contributes to the development of the IT sector and the implementation of innovative solutions in logistics. Logistics operators have emerged in Ukraine that implement the "data-driven organization" business model, where the IT department prepares models that allow individual departments in the company to analyze information and make decisions based on it (Rohlig SUUS Logistics company).
Risks and resilience of supply chains	Global crises have highlighted the importance of risk management and resilience, which involves diversifying suppliers, changing sources of goods supply, developing alternative routes and various scenarios for goods delivery.	In Ukraine, these factors have led to a rethinking of approaches to risk management, including creating backup stocks, diversifying suppliers, and developing new resilience strategies. At the same time, this has necessitated the activation of humanitarian logistics, as well as increased volumes of consolidated cargo transportation. This applies both to the segment of truck transportation (LTL – Less Truck Load) and container transportation (LCL – Less Than Container Load).
Impact on human resources	Changes in the global labor market caused by the pandemic and conflicts have led to changes in employee competency requirements.	Migration, mobilization, and changes in the economic situation have led to a redistribution of human resources and an increase in labor shortages. Due to the lack of professional staff, one of the key tasks today is to increase the involvement of women in so-called "male" work and adapt people with disabilities to logistical work processes. This increases the demand for retraining, learning new competencies, and implementing new approaches to human resource management.
Changes in infrastructure development priorities	Global investment flows are increasingly directed towards the development of critical infrastructure objects. Introduction of new types of transport (electric vehicles, drones, and autonomous vehicles).	Ukraine needs to rebuild destroyed infrastructure, attract international aid and investors, and develop recovery strategies that include modern infrastructure solutions aimed at improving the efficiency of logistics processes. Development of new transport routes and transport corridors (expansion of the pan-European TEN-T network to Ukrainian territory, formation of new "grain" corridors, etc.). Ukraine has a chance to become a world leader in the use of drones and unmanned systems for supplying military and civilian objects.

End of table 1

1	2	3
Environmental and sustainable practices, implementation of resource and energy-efficient technologies	Growing emphasis on sustainable development, environmental norms, and carbon emission reduction, requiring new approaches to supply chain management. Logistics companies are responding to this trend by developing environmentally friendly logistics solutions.	Active involvement of Ukrainian companies in the European Green Deal. The need to implement sustainable practices for entering international markets. Use of ESG criteria for selecting investment projects for post-war infrastructure reconstruction. Destruction of energy facilities and reduction in energy generation encourages Ukrainian enterprises to save energy and use alternative energy sources.

Source: (summarized by [1, 2, 3, 20, 35, 36])

The factors listed above necessitate significant transformations in the system of personnel training for the logistics industry, including higher education, as the implementation of digital technologies and digital solutions requires new knowledge and skills. On the other hand, transformations occur due to the introduction of innovations in business conduct and strategic supply chain management, which demands new competencies in data and analytics, strategic thinking, and the ability to quickly adapt to changes in a dynamic business environment. The first factor is more related to the concept of Industry 4.0, as it emphasizes technological solutions. We associate the second factor with the transition to Industry 5.0, which draws attention to socio-economic factors of industrial sector development and long-term human development. Some scientists believe that both industries should coexist, as the first is aimed at technological control, while the second focuses on values and societal needs [37].

Industry 5.0 has three main characteristics: human-centricity, resilience, and sustainability (European Commission, 2022 [38]). Human-centricity means that machines will be used to perform difficult, repetitive, or monotonous tasks, while humans will focus on more stimulating and creative work. Resilience refers to companies' ability to cope with turbulence and unforeseen situations and recover from unexpected events or problems. Sustainability emphasizes sustainable development and reducing the harmful impact of economic activities on the environment [24, 25, 39, 40].

By analogy, the term "Logistics 5.0" is used to denote a new stage in the development of logistics theory, which takes into account the impact of digital technologies, particularly artificial intelligence, data analytics, blockchain, and other innovations on logistics systems and processes. Logistics 5.0 aims to create even more intellectualized and automated logistics systems capable of adapting to market changes and providing higher efficiency and flexibility. It concerns not only individualized product distribution, inventory management and warehousing, or optimization of transport processes but also the interconnection of data, machines, and people in all logistics operations carried out in supply chains [39]. An attempt to explain the difference between Logistics 5.0 and Logistics 4.0 was also made by authors [41], who emphasized that the concept of Logistics 5.0 reflects the features of logistics in Industry 5.0.

It should be noted that some experts believe that Industry 5.0 is not timely for Ukraine, as most sectors of the economy are at the stage of industrial development 3.0. However, we believe that in the logistics sphere, there are real prerequisites for implementing the basic principles and technologies of the new technological order. The post-war reconstruction of the country's economy, primarily infrastructure, will require saving both natural and financial resources, adhering to the UN sustainable development goals and sustainable practices of the

European Union, integrating Ukrainian enterprises into international supply chains, and so on. The logistics industry operates in very specific conditions as it acts as a link in supply chains in various sectors of the economy, must meet the requirements of individual clients it serves on behalf of commercial enterprises, and is responsible for its own actions towards society and the economy by adapting to legal requirements, environmental and social trends.

Summarizing the research results of various authors, the main characteristics of Logistics 5.0 can be defined as follows:

– Integration with machine learning and artificial intelligence: The use of machine learning algorithms and artificial intelligence allows logistics systems to analyze large volumes of data, forecast demand, and optimize solutions in real-time.

– Autonomous transport and warehouse equipment: The development of autonomous vehicles and robotic warehouse management systems allows reducing costs and increasing the productivity of logistics processes.

– Blockchain and data security: The use of blockchain technology to ensure security and reliability of data in logistics systems, as well as to ensure transparency and traceability of supply.

– Individualized and personalized services: The application of data analytics and artificial intelligence allows logistics companies to create individual and personalized solutions for clients, increasing customer satisfaction and competitiveness.

Thus, Logistics 5.0 is characterized by a higher level of intellectualization, automation, and digitalization in logistics systems, allowing enterprises to be more flexible, efficient, and competitive in the market.

The above indicates the need to develop new competency models for logistics personnel and adapt existing educational programs for training logistics specialists to the changes that are already occurring, as well as to consider the trends of future logistics.

Currently, in the higher education system of Ukraine, there are several conceptual approaches to training specialists for the logistics industry:

A) Training of logistics managers, which is implemented as a separate educational program within the specialty 073 "Management",

B) Training of logistics engineers, which is implemented within the specialty 275.03 "Transport Technologies",

C) Training of economists within the specialty 076 " Entrepreneurship, Trade, and Exchange Activities ".

Each of these approaches has its advantages and weaknesses, depending on which aspects of logistics and management they choose to work on. Managers focus on managerial and strategic aspects, while engineers focus on technical and procedural aspects. Table 2 presents research results that, in our opinion, best reflect the competency requirements for logistics managers and engineers.

Summarizing the results of these studies, there is a convergence of competency sets for managers and engineers in logistics. Ideally, combining both approaches can ensure effective management and improvement of logistics processes. The main reasons for this convergence are:

- The growing role of digital technologies in logistics activities, as automation, robotics, the Internet of Things, data analytics, and artificial intelligence have a significant impact on both managerial and technical aspects of logistics;

- The need to integrate technologies into strategies, which involves using digital technologies to improve efficiency, reduce costs, and increase the speed of goods movement;

- The increasing complexity of logistics systems, and managing such systems requires knowledge of both managerial and technical-technological aspects;

- Data collection and analysis technologies are becoming critically important for decision-making in logistics, as

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the widespread use of automated management systems for transport, warehouse, and other logistics operations has contributed to the accumulation of large volumes of information that can be used to optimize business processes in supply chains and transport-logistics systems at various levels;

- The need to adapt to rapid changes in the logistics business environment, which involves using new technologies to develop alternative logistics solutions, considering risks, and preventing possible disruptions in both global supply chains and at the regional level.

Table 2. Comparative analysis of competency sets for logistics specialists

Skills of logistics and supply chain management managers (based on [21])	**Skills of logistics engineers (based on [42])**	**Skills of managers-economists (based on [43])**
Soft skills		
Supply chain analytics Technological ability Teamwork skills Customer orientation Leadership qualities Interpersonal communication skills Personal skills Creativity and resilience Negotiation skills Communication skills Emotional intelligence Adaptation skills Time management Knowledge of new social and digital media	Effective communication Problem-solving and critical thinking Adaptability and flexibility Team collaboration and leadership Time management and prioritization Attention to detail and accuracy Customer service orientation Conflict resolution and negotiation Cultural awareness and global perspective Continuous improvement and learning	Critical/analytical thinking Ability to learn, self-learn, and re-learn Ability to work in a team Planning and task prioritization Adaptability and flexibility Attention to detail Independent decision-making Problem-solving Communication skills Leadership and initiative Time management Emotional intelligence Negotiation Ability to build interpersonal relationships
Professional skills		
Supply chain analytics Demand and supply forecasting Project management Transportation/fleet management Warehouse management Asset and inventory management Reverse logistics	Supply chain management Transportation planning and analysis Warehouse Management Systems (WMS) Inventory management and optimization Data analysis and statistical analysis Enterprise Resource Planning (ERP) systems Geographic Information Systems (GIS) Process improvement methods (e.g., Lean, Six Sigma) Project management and planning Compliance and regulatory knowledge (e.g., customs, security)	Data analysis Business analysis Financial management Strategy and change management Project management Sales and negotiation Marketing analysis PR, communications, and copywriting Use of promotion channels Customer experience

Thus, the convergence of competency sets for managers and engineers in logistics occurs due to the growing importance of technologies and the need to integrate technical knowledge into management strategies. Logistics 5.0 requires new

competencies from managers that combine technological knowledge, analytical skills, managerial abilities, and attention to sustainable development. The competency model should take these aspects into account to ensure effective management of modern supply chains and compliance with new market requirements.

It should also be noted that the competency sets of logistics managers and engineers are constantly changing under the influence of modern challenges, technological innovations, globalization, environmental and social requirements, crisis situations, etc. This means that traditional competencies are being transformed and new competencies are emerging. For example, instead of simple supply chain management, modern managers must be able to implement and use digital tools for automating and optimizing supply chains, integrate artificial intelligence-based systems for real-time demand forecasting and inventory management. The implementation of intelligent transport systems that use Internet of Things technologies for real-time monitoring and optimization of transport processes includes automated vehicle management and unmanned systems for goods delivery. Modern automated warehouse management systems use robotic systems and drones to optimize warehouse operations.

Thus, the set of competencies of a logistics manager should be considered as an integrated system that helps achieve the organization's strategic goals in conditions of constant changes in technologies, market conditions, and challenges. This system can be described by a competency model that presents a structured description of knowledge, skills, behavioral characteristics, and other qualities necessary for successful performance of specific work tasks or achieving productivity in a certain position. Taking this into account, we have developed a new competency model for logistics and SC managers, which includes four important components: knowledge, skills, behavioral characteristics, and motivation (Fig. 1).

Therefore, logistics managers should know the evolution of logistics concepts and supply chain management, patterns of creation and development of logistics systems, characteristics and integration of business processes in supply chains, methodology for developing and making logistics decisions at strategic, tactical, and operational levels. In addition to subject area knowledge, logistics managers should have technical and technological knowledge, particularly organizational and technological schemes of logistics processes, features of using information and information-communication technologies for monitoring goods movement, data analysis and processing, demand forecasting and inventory management, transportation and warehousing management using automated and robotic systems, automation of production processes, etc.

The skills of logistics managers should be aimed at managing logistics processes and projects for developing logistics systems at micro-, meso-, and macro-levels, adapting to new technologies, forming innovative thinking, and understanding how innovations can affect logistics business processes and supply chain competitiveness.

Behavioral characteristics are oriented towards developing systemic thinking and interpersonal skills, primarily aimed at human-machine collaboration in automated and robotic logistics systems, effective communication in an environment where people and technologies interact, managing interdisciplinary and intercultural project teams, etc.

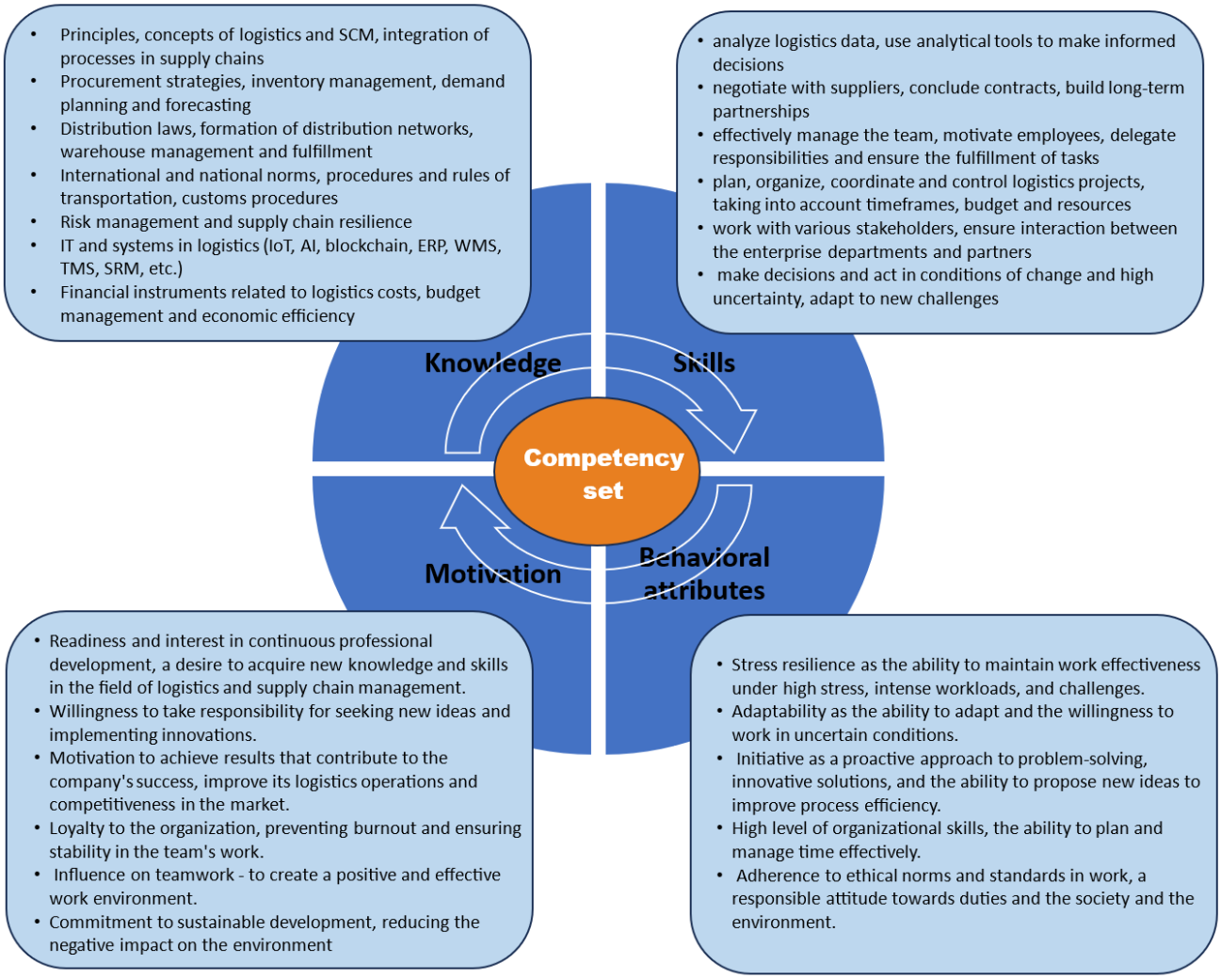

Figure 1 – Competency model for logistics and SC managers in Industry 5.0

The inclusion of the fourth component "Motivation" in the model corresponds to the modern understanding of competence, which can be described by the formula "I know, I can, I'm able to, and I want to," i.e., how capable a specialist is in applying acquired knowledge, abilities, and skills in real conditions of professional activity. Even if a person has a high level of knowledge and skills, without proper motivation, they may not use them effectively. In the proposed model, a logistics manager should have an interest in continuous professional development, strive to acquire new knowledge and skills in logistics and supply chain management, achieve results that contribute to the company's success, increase the efficiency of its logistics operations, and competitiveness in the market.

It should be noted that Industry 5.0 emphasizes the integration of technologies to increase efficiency and reduce negative environmental impact, which includes implementing sustainable practices in logistics and supply chain management. That is why logistics managers should be able to implement sustainable practices and solutions to reduce harmful emissions into the environment, demonstrate high ethical awareness and social responsibility in decision-making, and have a commitment to sustainable development as part of corporate culture and personal professional values.

The change in competency models for logistics managers necessitates adjusting academic training programs to prepare students for new requirements and realities of the profession. The proposed competency model for logistics managers has been implemented in the new edition of the "Logistics" educational program at the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute".

		Courses for bachelor's degree in logistics	Courses for masters's degree in logistics
Hard Skills	Understanding the concepts of logistics and SCM	Basics of logistics. Supply, production and sales logistics.	Sustainable supply chains strategic management. Environmental management.
	Management and optimization of logistics operations and business processes (transportation, warehousing, inventory management, order fulfillment, etc.).	Operational management. Transport logistics. Warehouse logistics. Reverse logistics. Quality management, lean production and logistics.	Logistics management. Demand forecasting and inventory management. Global Procurement in Supply Chains.
	Knowledge of international and national regulation of logistics activities and risk management.	International economic relations. Customs logistics. Risk management.	Global customs logistics. International settlement operations in logistics. International transport and logistics systems.
	Strategic planning and development of logistics systems, forecasting costs and optimizing budgets for logistics activities, increasing the supply chains competitiveness.	Enterprise economy. Company finances. Business forecasting. Integrated planning of logistics support for production.	Design of logistics infrastructure objects. Innovation technologies in logistics systems.
	Communication and partnership with suppliers, customers, and other stakeholders in changing market conditions.	Management. Marketing. HR management. Behavioral economics.	Reputational capital in logistics. Logistics consulting.
	Business analytics and modeling of logistics processes using digital technologies.	Business statistics. Economic analysis. Technology systems and digitization. IT in logistics.	Intellectualization of the logistics services market. Analytical statistics using the R language.
Soft Skills	Language and information communications	Language culture and business communication. Foreign language. Information systems and technologies. Digital transformations.	Foreign language for business communication.
	Self-organization and time management	Basics of a healthy lifestyle. Self-management. Recruitment. Career coaching.	Training "Logistics of crisis situations"
	Data analytics	Mathematics for managers. Probability theory and mathematical statistics for managers. Data visualization. Blockchain and artificial intelligence in business.	Training course "Critical thinking". Business analytics in logistics.
	Leadership and team development, use of agile project management technologies for rapid adaptation to changes, human-centric orientation of corporate governance and corporate social responsibility.	Leadership and business communications. Psychology of conflict. Training "Crisis communications". Creative management.	Logistics Cost Optimization Project Management. Corporate Governance

Figure 2 – Key competencies and academic disciplines from the educational program "Logistics" curriculum

The purpose of this educational program is to train specialists who possess systemic thinking and are suitable for professional logistics activities in various economic sectors, with a wide range of general and professional competencies, to provide entities of various organizational and legal forms with qualified personnel in the field of logistics process management. The uniqueness of the proposed program is due to its priority orientation on forming pro-innovative competencies of logistics managers capable of effective work using modern digital technologies and oriented towards partnership and interaction in supply chains. The program combines knowledge of management, logistics, economics, information technology, law, finance, operations management, etc. Figure 2 contains a list of key competencies and academic disciplines provided in the curriculum for educational program "Logistics".

Thus, an updated educational program is critically important for training logistics managers capable of successfully working in Industry 5.0 conditions and successfully coping with future challenges. It is adapted to modern requirements, includes new technologies, soft skills development, sustainable development, analytical abilities, and practical experience.

To verify the acquired knowledge and formed skills, a system of program learning outcomes is extremely important, which should be oriented towards fostering human-centricity, sustainability, flexibility, and digital transformation in logistics management. To better understand the needs and requirements of business, establish partnerships, and ensure the possibility of internships for students at domestic enterprises, we have developed a matrix of maturity of logistics competencies, which allows determining the degree of formation of knowledge, skills, and abilities. Usually, such matrices are developed by companies to identify the current level of competency maturity in the organization, identify weaknesses, and develop personnel development plans. This tool can be used by universities to evaluate the effectiveness of their educational programs, develop new courses, and improve forms and methods of classroom and independent work of students.

Table 3 presents our proposed maturity matrix of logistics managers' competencies, which provides for 3 levels of formation, as well as key performance indicators (KPIs) for measuring students' academic achievements and their ability for self-development.

For each level of competency, the main forms of classroom and extracurricular student work, incentives for obtaining in-depth knowledge and forming innovative thinking are defined:

A. Basic or initial level reflects a basic understanding of the main concepts and principles of logistics, knowledge of logistics processes, ability to develop and justify logistics solutions using basic information systems and procedures.

B. Advanced level involves a deeper understanding of various functional areas of logistics and integration of logistics processes with other business processes in supply chains, knowledge of international standards and best practices in logistics and supply chain management, ability to conduct data analysis to optimize logistics processes using various software.

C. Innovative level requires deep knowledge of the latest trends and digital technologies in logistics and supply chain management, the impact of Industry 5.0 on logistics processes, including the integration of people and technologies to create personalized solutions, ability to develop sustainable development strategies for logistics systems of various complexity levels, considering environmental, social and economic aspects, identifying ways to increase the efficiency of logistics activities and competitiveness of supply chains.

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Table 3. Structure of the maturity matrix of logistics managers' competencies (author's contribution)

Competences	**Levels of formed competences and learning outcomes**			**KPI**
	Basic	Advanced	Innovative	
Knowledge	Knowledge of the basics of logistics, concepts and principles of logistics, management of logistics business processes in supply chains	Deeper understanding of functional areas of logistics, integrated management of business processes in supply chains, development of logistics strategies and their impact on the competitiveness of supply chains.	Deep knowledge of the impact of Industry 5.0 concepts on logistics processes, including the integration of people and technology to create personalized solutions. The ability to develop strategies for the sustainable development of logistics systems, taking into account environmental, social and economic aspects.	Student success in basic courses. Solving cases, carrying out mini-researches, business games and trainings.
Skills	Mastering basic instruments and performing basic operations.	Successful solution of complex cases, data analysis and decision-making skills. Participation in thematic webinars and online courses.	Strategic thinking, development of innovative solutions, participation in interdisciplinary projects, initiation of real or simulated logistics projects.	Percentage of students.
Behavioral attributes	Communicative learners, responsibility and discipline, adaptability and ethical behavior (academic integrity)	Leadership qualities, creativity and innovative thinking, the ability to work in a team, taking into account the opinions of others, and contribute to the overall result	Strategic vision, emotional intelligence, flexibility and openness to change, adaptability to cultural contexts, participation in exchange and academic mobility programs.	Percentage of students.
Motivation	Attitude to learning, performance of classroom and independent tasks, discipline and personal responsibility.	Participation in extracurricular activities: student clubs, circles, conferences, competitions, workshops or internships in companies related to logistics.	Proactivity, leadership motivation in team projects, volunteering, participation in social and environmental projects, participation in global sustainable development initiatives.	Percentage of students

To assess the maturity of students' knowledge at different levels of competency, indicators (KPIs) of student success, individual student ratings, the proportion of students participating in various classroom and extracurricular activities, olympiads, competitions, business and scientific projects, academic mobility programs, etc. can be used. These KPIs will help track student

progress at each maturity level and ensure that curricula match their development.

The existing system of knowledge and academic skills assessment at KPI stimulates students' creativity. Students can receive bonus points in academic disciplines for participating in scientific work competitions on the subject of the discipline or for in-depth study of specific topics, the results of which are presented in the form of scientific theses, essays, presentations, scientific articles, etc., completing online courses on the subject of the discipline. There is also a system for recognizing learning outcomes acquired through non-formal or informal education.

It's also worth noting that NTUU "Igor Sikorsky Kyiv Polytechnic Institute" is a research university, which means it is not only a source of new knowledge and technologies but also a platform for developing skills that allow future specialists to successfully adapt and work in the conditions of Industry 5.0. The university has created an innovative ecosystem "Sikorsky Challenge Ukraine" (SCU), which currently unites structural units of the university (KPI Department of Innovation and Technology Transfer, KPI Research Division, KPI Intellectual Property Center, KPI TechnoHub, Sikorsky Challenge KPI Startup School, Institute of Advanced Defense Technologies), as well as 15 regional/city innovation clusters, dozens of enterprises, business associations, and foundations. Through conducting fundamental and applied research, the university contributes to the creation of new technological solutions and approaches, which are subsequently integrated into educational programs and prepare students for work in the modern digital environment. This allows students to acquire comprehensive competencies that meet the requirements of the modern labor market, where not only technical skills are important, but also the ability to integrate knowledge from various fields.

Conclusions and Further Research Prospects. Logistics as a field of professional activity is undergoing significant changes. The speed at which these changes are occurring is most striking, but at the same time makes logistics an interesting, dynamic industry that never stops and is always at the forefront of all global trends and challenges. In recent years, during the global Covid-19 pandemic, the intensification of trade wars and armed conflicts in various regions of the world, a volatile market environment, and significant uncertainty, logistics and supply chains have come to the forefront of special attention not only for businesses but also for international organizations and entire regions and individual countries. The issue of ensuring the continuity and sustainability of logistics processes has never been as critical worldwide as it has been in the last 2-3 years. Global transformations require logistics personnel to pay more attention to systematicity and speed of decision-making, control at all stages of the supply chain, the need to develop alternative scenarios for product movement, ensure flexibility and efficiency of product delivery to different regions of the world, and design supply networks to meet demand in real-time.

The analysis of the main trends in the development of the global logistics services market allowed us to identify and systematize key factors influencing the transformation of the logistics industry, as well as to investigate the peculiarities of these factors' manifestation in Ukraine.

It was proven that the processes associated with changes in technological structures and the transition from Industry 4.0 to Industry 5.0 have the greatest impact on the transformation of competence of logistics and supply chain management managers. This means that the importance of information and communication, digital, personal, and interpersonal skills is growing. Highly qualified specialists can stimulate technology development and develop digital logistics solutions for systems of various complexity levels, as well as effectively implement and use digital technologies for data processing, optimization of logistics

processes, cost reduction, and increasing the speed of product movement.

This means that traditional competencies are being transformed and new competencies are emerging. Instead of simple supply chain management, modern managers must be able to implement and use digital tools to automate and optimize supply chains, integrate artificial intelligence-based systems for demand forecasting and real-time inventory management. The implementation of intelligent transport systems that use Internet of Things technologies for real-time monitoring and optimization of transport processes includes automated vehicle management and unmanned systems for product delivery. Modern automated warehouse management systems use robotic systems and drones to optimize warehouse operations. In general, logistics and supply chain management managers need to learn to cooperate with artificial intelligence, using an approach known as "human-machine collaboration" or "collaborative intelligence," which manifests itself in the use of artificial intelligence to cover human weaknesses or automate routine tasks. Such a specialist must possess strategic thinking and creativity, while artificial intelligence can provide speed in processing large data sets, finding correlations, making predictions, and providing recommendations.

Summarizing the results of scientific research by many scientists and analytical reviews concerning the development and transformation of competency models for logistics personnel, the selection and assessment of the significance of general and professional competencies allowed us to develop an author's competency model for logistics managers, which represents an integrated system of structured knowledge, skills, behavioral characteristics, and other qualities necessary for the successful performance of specific work tasks. The novelty of this model is the separation of the "Motivation" component, which corresponds to the modern understanding of competence, which can be described by the formula "I know, I can, I am able, and I want." In the proposed model, a logistics manager should have an interest in continuous professional development, strive to acquire new knowledge and skills in logistics and supply chain management, achieve results that contribute to the company's success, improve the efficiency of its logistics operations, and enhance competitiveness in the market.

The changing competency models for logistics managers necessitate adjustments to academic training programs to prepare students for new demands and realities of the profession. The proposed competency model for logistics managers has been implemented in the new edition of the "Logistics" educational program at the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute". The uniqueness of the proposed program is its priority focus on developing pro-innovation competencies of logistics managers, capable of working effectively using modern digital technologies and oriented towards partnership and interaction in supply chains. The program combines knowledge from management, logistics, economics, information technology, law, finance, operations management, and more. Industry 5.0 emphasizes the need to integrate advanced technologies such as artificial intelligence, robotics, and big data, necessitating the inclusion of new courses in educational programs aimed at developing relevant knowledge and skills. Moreover, it is important to develop interdisciplinary competencies that will allow students to combine technical knowledge with management and communication skills, which is particularly relevant in the context of modern challenges. Sustainability and social responsibility are central to Industry 5.0, requiring a revision of educational programs to account for environmental and ethical aspects, as well as providing students with opportunities to master sustainable development practices.

To better understand the needs and requirements of business, establish partnerships, and provide opportunities for

student internships at domestic enterprises, we have developed a matrix of logistics competency maturity that allows determining the degree of formation of knowledge, skills, and abilities. Three levels of academic competency formation are proposed, as well as key performance indicators for measuring students' academic achievements and their capacity for self-development. Due to rapid changes in technology and the business environment, the use of the logistics competency maturity matrix should promote the development of flexible thinking and adaptability in students, including strategic management, change forecasting, and crisis management. Participation in various business events, trainings, seminars, etc. will strengthen the practical component of the educational program, providing students with opportunities to gain real experience through internships, educational projects, business cooperation, and participation in mobility programs.

Thus, the proposed comprehensive approach, which involves developing a competency model for logistics managers in Industry 5.0 conditions, has allowed for improving the content and structure of the "Logistics" educational program, taking into account trends in the logistics services market and forecasts for the future development of the logistics industry. It has helped determine the relationship between general and professional skills, the set of necessary tools and technologies for developing and implementing logistics solutions, stimulate students to improve their knowledge, skills, and abilities, and orient them towards effective professional activity in the future.

Prospects for further research on improving educational programs considering Industry 5.0 requirements can be defined through several key directions. Firstly, it is important to investigate the effectiveness of implementing new technological courses and their impact on students' competency formation, which will allow assessing how well curricula meet modern labor market requirements. Secondly, attention should be paid to the interdisciplinary approach to learning, which is relevant in conditions of growing integration of various knowledge fields. Research can focus on developing and implementing teaching methods that promote students' skills in working at the intersection of different disciplines, as well as evaluating their effectiveness. Additionally, a promising direction is studying the integration of practical experience into the educational process, particularly through internships, business cooperation, and mobility programs, which will help identify best practices for preparing students for real challenges in professional activities. It is also worth continuing research on the impact of sustainability and social responsibility on the content of educational programs, as these aspects are gaining increasing importance in the modern business environment. Finally, research prospects may focus on developing innovative methods for assessing student competencies considering new Industry 5.0 requirements, which will ensure quality monitoring and correction of the educational process to achieve optimal training results. .

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DIGITIZATION OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT

Svitlana Smerichevska, Larysa Prodanova, Oleksandr Yakushev. "Digitization of logistics and supply chain management". *The article presents theoretical and applied aspects of digitalization of logistics and supply chain management. It is emphasized that the processes of digitalization of supply chains and logistics are a modern requirement for increasing business efficiency, as well as solving environmental, social and management problems of successful companies. Digitization of supply chains and logistics is defined as the integration of digital technologies and the implementation of digital tools to optimize, automate and increase the efficiency of all stages of the logistics process. Key modern technologies in logistics and supply chains are examined, including artificial intelligence (AI), the Internet of Things (IoT) and Big Data. The role of AI in optimizing logistics processes, forecasting market behavior, inventory management and route planning is outlined. Emphasis is placed on the importance of IoT for tracking goods, monitoring storage conditions and vehicle maintenance. The role of Big Data in optimizing supply chains, improving decision-making and compliance with regulatory requirements is analyzed. The use of digital documentation and electronic document circulation are highlighted as important areas of digitization. The difference between digitization of documents and digitalization of document circulation is revealed: digitization, or digital preservation, refers to*

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the transfer of information from paper documents to electronic format for convenient and safe storage of files and access to them in the future; digitalization involves the creation of documentation in computer applications, its intelligent processing and analysis, its accumulation in digital repositories, and the wide use of its data to solve various problems. It is noted that one of the main directions of digitization of documents is the automated reading of documents and data entry, which is implemented using specialized software for automatically extracting information from paper documents and entering it into digital systems. The list of the main logistics documents that are subject to digitization and the digitization of which leads to an increase in the efficiency of the supply chain (delivery confirmation, bill of lading, packing lists, invoices, cargo manifest, etc.) is provided. It was concluded that digitalization of logistics is a significant factor for modern companies seeking to increase their competitiveness in the market. It also enables the integration of all company divisions, improves product tracking, speeds up customs procedures, optimizes transport costs and increases the flexibility of return management. Despite the shortcomings that accompany this process, digitalization of logistics is necessary to achieve sustainable development and effective management of supply chains in today's world.

***Keywords**:* digitalization, Logistics 4.0, logistics, supply chains, logistics documents, digital technologies.

Світлана Смерічевська, Лариса Проданова, Олександр Якушев. «Цифровізація логістики та управління ланцюгами постачання». *У статті представлені теоретичні та прикладні аспекти цифровізації логістики, який передбачає впровадження цифрових рішень на всіх етапах логістичного циклу для моніторингу та управління процесами в усьому ланцюжку постачання. Акцентовано, що процеси цифровізації ланцюгів постачання і логістики є сучасною вимогою підвищення ефективності бізнесу, а також вирішення екологічних, соціальних та управлінських проблем успішних компаній. Попри переваги, цифровізація стикається з низкою викликів, які потрібно подолати для її успішного впровадження. Цифровізація ланцюгів постачання і логістики визначена як інтеграція цифрових технологій та впровадження цифрових інструментів для оптимізації, автоматизації та підвищення ефективності всіх етапів логістичного процесу. Розглядаються ключові сучасні технології, що використовуються в цифровій трансформації логістики, зокрема штучний інтелект (AI), Інтернет речей (IoT) та аналіз великих даних (Big Data). Обґрунтовано, що такі технології забезпечують підвищення інформаційної взаємодії, ефективність управління запасами, оперативність інформаційного забезпечення та точність процесів. Зазначено, що впровадження цифрових технологій стикається з такими труднощами як недостатність кваліфікованої робочої сили та доступність даних. Як важливі напрямки цифровізації виокремлено: застосування цифрової документації та електронний документообіг. Розкрито різницю між оцифруванням документів і цифровізацією документообігу. Зазначено, що одним із основних напрямків цифровізації є автоматизоване читання документів і введення даних, які реалізуються із застосуванням спеціалізованого програмного забезпечення для автоматичного вилучення інформації з паперових документів і введення її в цифрові системи. Наведено перелік основних логістичних документів, які підлягають цифровізації, оцифрування яких зумовлює підвищення ефективності ланцюжка постачання (підтвердження доставки, коносамент, пакувальні листи, рахунки-фактури, вантажний маніфест та ін.). Зроблено висновок, що цифровізація логістики: є вагомим чинником для сучасних компаній, які прагнуть підвищити свою конкурентоспроможність на ринку; попри недоліки, цей процес є необхідним для досягнення сталого розвитку та ефективного управління ланцюгами постачань у сучасному світі.*

Ключові слова: цифровізація, Logistics 4.0, логістика, ланцюги постачання, логістичні документи, цифрові технології

Introduction. The digitalization of logistics involves implementing digital solutions at all stages of the logistics cycle for monitoring and managing processes throughout the supply chain, from the receipt of raw materials to the final delivery of the product. Digital transformation in the logistics sector requires increased investment in

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modern tools, systems, and technologies to optimize resources, ensuring efficiency. To achieve successful digitalization of logistics in a company, it is necessary to promote the quality use of new technologies. Although this is a necessary and beneficial process, in practice, the digitalization of logistics may face a number of obstacles and problems that need to be overcome for its successful implementation in companies.

Analysis of recent research and publications. The methodology, concepts, optimization models, and strategies for logistics and supply chain management based on the implementation of digital technologies have been formulated and revealed in many foreign and domestic scientific works. In particular, authors O. A. Pokhylchenko [17], B. Bigliardi et al. [2], Yu. O. Shkrygun [22], N. V. Trushkina and K. Yu. Kitrish [21] argue that with the development of the Industry 4.0 concept, the Logistics 4.0 concept emerged, which scientists define as management using advanced technologies of flows of raw materials, semi-finished products, and finished products to meet customer needs. The spread of digital technologies in the industrial sector inevitably has consequences for logistics as well [2]. Based on these, as noted by S. Schrauf and Ph. Berttram [6], new business models are created that integrate every link in the company's value chain: digital workplace, product development and innovation, design and production, distribution, digital sales channels, and customer relationship management. Research has shown that Industry 4.0 will have the greatest impact on the areas of order fulfillment and transport logistics [19]. The supply chain concept developed in the article by M. V. Boychenko [14] is most fully realized in the Logistics 4.0 system.

S. Hrytsenko explores the possibilities of applying digital technologies at the local level in the formation of transport and logistics clusters. The author notes that the implementation of intelligent transport systems, which represent a combination of modern technologies, transport infrastructure, facilities, and users, will provide a higher level of mobility, safety, environmental friendliness, and economic efficiency of transport services [15, p. 350].

Based on the analysis of specific technologies such as artificial intelligence, Internet of Things, and blockchain, J. D. Torres Leandro emphasizes the advantages of focusing on their use in supply chain management, namely: improving information interaction between subjects influencing supply chains; efficiency of inventory management and its reduction; operational information support in making management decisions; ensuring accuracy of processes and location of goods, which improves management and customer service [9].

Given the presence of a wide range of theoretical developments, it is worth focusing on specific practical aspects of digitalization in logistics and supply chain management.

Formulation of the article's objectives. The purpose of this article is to analyze the current state and practices of implementing digitalization in logistics and supply chain management.

Presentation of the main material. The use of digital technologies in supply chains is a requirement of our time. Along with increasing economic efficiency, digitalization allows overcoming environmental, social, and governance (ESG) issues. As research by the international audit and consulting firm PwC shows, hundreds of surveyed executives and company leaders in the US recognize the benefits of digital transformation in supply chains. Among these companies, 62% have invested in cloud technologies and artificial intelligence, including 55% in machine learning technology. The main areas of activity in which these technologies are used are quality control, operational visibility, and analytical work [5].

As the digitalization of supply chains is a revolutionary transformation with a lack of theoretical achievements and practical experience, it is accompanied by many challenges. Thus, up to 70% of company

executives admit that their investments in operational technologies have not yielded the expected results. Most companies focus more on basic, immediate priorities and problems in their supply chains and less on actions and investments that can help transform supply chains and create long-term value. Despite the large number and potential of technologies, few executives say their companies are using or planning to use them to automate and improve the execution of various supply chain elements in at least the next 2 years. Only about a third of executives say that increasing resilience is the main goal of investing in supply chain technologies. Regarding risk, 86% of respondents agree that their company should invest more in technologies to detect, track, and measure supply chain risk. More than two-thirds of respondents expect that digitalization of their supply chain will require upskilling of employees. Respondents note a reduction in the supply of skilled labor, so they are willing to work with their own staff, including retraining employees for other jobs as their current roles will no longer be needed. Additionally, companies plan to reduce dependence on outsourcing. Lack of digital skills among employees (80%) and availability of data and digital tools (73%) were the most frequently mentioned challenges for integrating ESG into the company's supply chains [12].

The digitalization of logistics provides advantages that optimize the supply chain operation and increase efficiency in all areas of the company's activities. It allows integration with other departments of the company, facilitating coordination of activities and decision-making. Product tracking is improved, making it possible to determine their location and condition in detail at any time. Digitalization also accelerates customs procedures, simplifying bureaucratic processes and reducing waiting times. Additionally, it facilitates order picking and cross-docking, optimizes order preparation, and direct delivery to the end-user. Another important advantage is the simplification of transportation planning through software specialized in route organization, the implementation of which leads to resource optimization and reduction of transportation-related costs. Reverse logistics, i.e., delivery and returns, becomes more flexible thanks to digitalization. This facilitates returns management and simplifies the processes of refunds or product replacement. The digitalization of logistics also improves demand forecasts, allowing for the adaptation of production and supply according to market needs.

The digitalization of supply chains and logistics means the integration of digital technologies into all their aspects, from automating storage and distribution processes to using advanced software for inventory management and route planning. Logistics management technologies are important tools for ensuring supply chain resilience and effectively responding to future disruption risks, aimed at increasing efficiency, reducing costs, and improving decision-making processes throughout the supply chain, thus contributing to more flexible, accurate, and market-adapted logistics [8; 20].

Let's characterize some modern technologies in logistics and supply chains.

Artificial Intelligence (AI) is a revolution in the logistics sector, enabling it to achieve ultra-high efficiency in process optimization and customer satisfaction, ensuring long-term stability of digital business. Through the application of AI, companies are transforming their procedures into proactive schemes. Operators can predict market behavior and allocate resources appropriately, leading to increased productivity and reduced costs. The successes in implementing artificial intelligence in logistics are due, in particular, to increased market competition. To remain competitive while optimizing operations in supply chains, logistics companies are forced to invest in technologies [6]. Figure 1 shows the level of artificial intelligence implementation in supply chains and manufacturing businesses, which is

determined by the corresponding shares of respondents' answers..

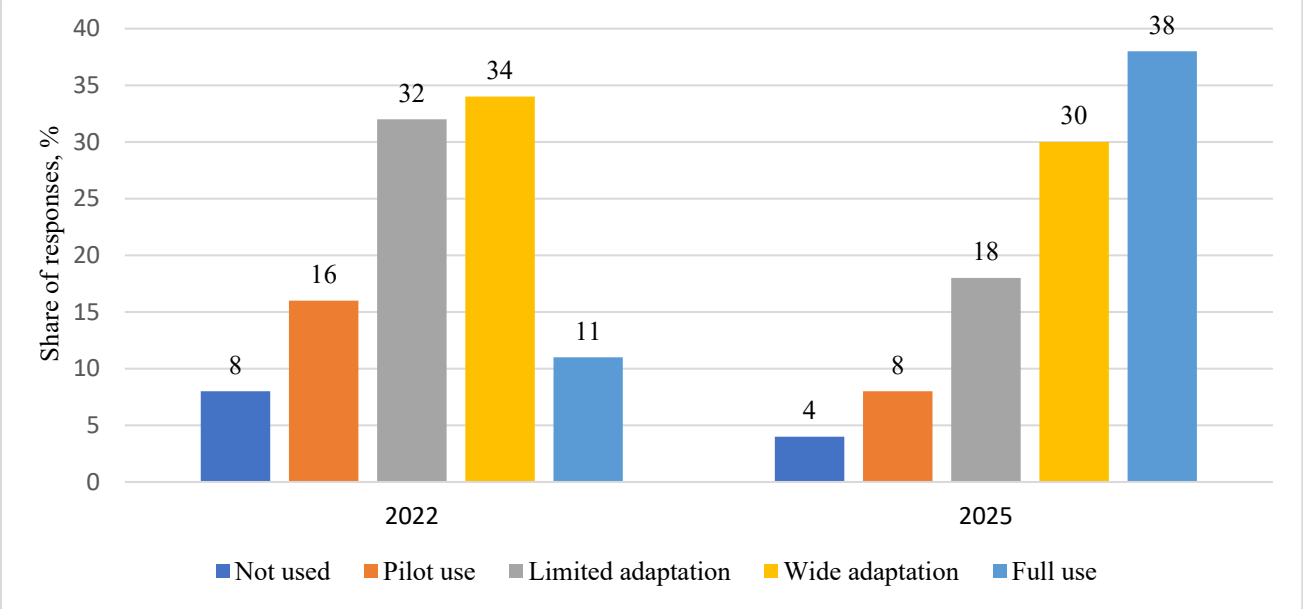

Figure 1 – Level of adoption of AI in supply chains and manufacturing in the world in 2022 and 2025 (forecast)

Source: developed by the authors from [2]

From Figure 1, we can see that in 2022, one-third of executives were preparing for wide and full-scale implementation of AI. It is expected that by 2025, the level of full-scale AI implementation will increase to almost 38%.

AI is used in warehousing, inventory, order preparation, and transportation processes. In inventory control, the application of resource planning software with integrated artificial intelligence and robots allows for efficient inventory management and optimization of storage space. Products are placed according to their arrival, and locations are chosen based on their expected rotation, maximizing the use of available resources.

Thanks to data-based machine learning, artificial intelligence can predict future customer orders and adjust inventory accordingly. Mass analysis of internet browsing and online purchase data provides the ability to observe consumer habits of real and potential buyers, forecasting trends in consumer behavior.

AI enables coordination and optimization of transportation. This technology allows for planning trips at the most appropriate times and selecting the best routes. This achieves a reduction in distance and CO2 emissions associated with trips, ensuring an environmentally friendly approach and ecological responsibility in logistics. AI is used in the global cargo drone market. The current state and forecasts of the relevant AI applications are shown in Figure 2.

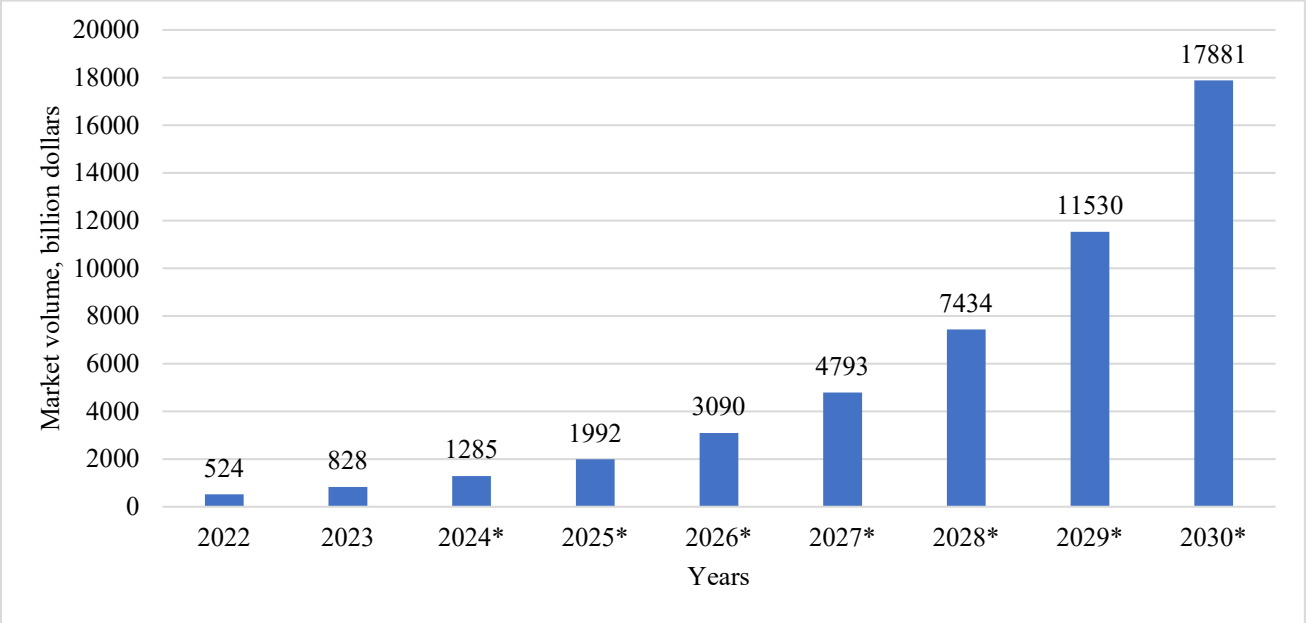

Figure 2 – Total value of the global market for cargo drones in 2023, with a forecast (*) until 2030
Source: developed by the authors from [10]

According to Figure 2, by 2030, the global cargo drone market is expected to double, reaching 17.88 billion US dollars. The most dynamic growth is predicted to occur between 2027 and 2029.

Chatbots created using AI play an important role in the retail sector. These virtual assistants provide customers with a personalized experience, facilitating online shopping and offering assistance in offline stores. AI is also used for quality control. Monitoring with this technology allows for detecting errors and time losses, implementing early corrective processes, and reducing operational costs. Regarding human resources, the use of AI allows for utilizing physical labor and human talent for more skilled and creative tasks, while routine work is subject to automation. One of the main directions of digital logistics is the use of machine learning for optimal decision-making. For instance, it can determine the best route for transportation, efficiently organize a warehouse to meet demand in the next period, or calculate the optimal number of necessary suppliers. Furthermore, machine learning can be applied to clean databases of errors and missing data, mainly in those databases that are manually generated.

The Internet of Things (IoT) is transforming the logistics industry, providing accurate real-time tracking of goods, as well as monitoring their storage conditions, which significantly improves inventory management and overall warehouse efficiency. One of the main advantages of IoT in logistics is that, thanks to radio-frequency identification (RFID), Bluetooth, NFC tags, and GPS, it is possible to determine the exact location of goods at any time, as well as exchange information between participants in the supply chain [19].

The potential of IoT is not limited to inventory tracking but also extends to vehicle maintenance: IoT systems can predict when a vehicle will need maintenance before a breakdown occurs, thus minimizing downtime. IoT devices can track driving patterns and driver behavior, providing feedback that will promote safer driving and improve fuel efficiency.

The IoT architecture of the logistics industry consists of five distinct levels: perception, access, network, support, and applications. At the perception level, data is collected and signals are received through physical devices. The access level responds to sensory requests for transmitting received

data in networks such as 3G, 4G, 5G, WiFi. By sending a signal from the access level to the support level, the network level completes the signaling process. The support level provides data processing tools and platforms. The application level establishes a connection between IoT and its consumers [11].

Big data analysis using artificial intelligence algorithms allows companies to improve decision-making processes, optimize the supply chain, and increase overall efficiency. The expansion of global supply chains generates enormous amounts of data from many sources, requiring advanced analytics for efficient operation and management. Big data allows logistics companies to optimize supply chain operations by providing information on inventory levels, demand forecasts, and real-time shipment tracking. This contributes to more efficient route planning, reduced fuel costs, and shortened delivery times. Customers demand accurate and timely information about order status, delivery times, and product location.

Governments and regulatory bodies are introducing stricter data management and reporting rules. Big data solutions allow companies to comply with these rules by providing accurate and timely data. For example, in May 2024, the European Union's transport regulator emphasized the role of big data in helping logistics companies meet new emission standards. Using big data, logistics companies can improve vehicle utilization, optimize routes, predict maintenance needs, control emissions, and develop low-carbon strategies. The EU's focus on big data signals to the industry that data-driven decision-making is crucial for compliance and competitiveness. By leveraging the power of data, logistics companies not only meet environmental regulations but also gain a competitive advantage [3].

The digitalization of logistics involves moving away from paper and reducing manual operations. This not only contributes to environmental protection but also optimizes processes, reduces errors, and increases the overall efficiency of the company. The transition from paper to digital documentation in logistics is driven by the globalization of supply chains, and the increasing complexity and acceleration of logistics operations. It's important to understand the difference between digitization and digitalization. Digitization, or digital preservation, refers to transferring information from paper documents into an electronic format for convenient and secure storage and future access to files. Digitalization involves creating documentation in computer applications, intelligent processing and analysis, accumulation in digital repositories, and extensive use of its data to solve various tasks. In the context of supply chain and logistics, digitalization is crucial for optimizing operations, reducing the risk of data loss, and ensuring real-time access to information. The reason why supply chain and logistics companies are increasingly choosing document automation technologies is that they offer several advantages over traditional paper processes. These include increased accuracy and efficiency, reduced costs, improved supply chain visibility, and the elimination of repetitive tasks for staff in favor of other high-value activities. Through digital documentation, logistics companies can ensure they have the necessary information when they need it to make informed decisions and maintain smooth operation of their supply chain [18, p. 119].

One of the main directions in document digitalization is automated document reading and data entry. Specialized software is used for this purpose to automatically extract information from paper documents and input it into digital systems. This eliminates the need for manual data entry, which is time-consuming, can cause errors, and often results in incomplete or incorrect information. There are various document digitalization technologies, including Document Understanding and Intelligent Document Processing, based on the use of artificial

intelligence, machine learning, natural language processing, and advanced optical character recognition mechanisms. These technological solutions provide end-to-end automation of document-oriented processes. By collecting, extracting, classifying, and analyzing information from documents of various types and formats, they enable data integration within workflow automation. Through the automation of document-oriented processes, intelligent document processing can free up time and resources, allowing supply chain companies to focus on core activities, increasing efficiency and reducing costs. For example, in working with images, particularly for recognizing the presence or absence of stamps when processing paper documents, an effective approach is machine learning using convolutional neural networks [16].

Let's consider some types of logistics documents that can be automatically digitized to improve supply chain efficiency and reduce manual data entry errors [1]. These include:

1) Proof of Delivery (POD). POD documents confirm that a shipment has been delivered and serve as the basis for invoicing and customer service. Digitizing PODs helps speed up the billing process and provides real-time visibility of delivery status;

2) Bill of Lading (BOL). This is a legal document that defines the type, quantity, and destination of goods being transported. Digital transformation of bills of lading helps automate carrier selection and routing, improve accuracy and speed of invoicing and payment processes;

3) Bill of Lading Instructions. Many companies offering transportation services receive specific instructions from their clients regarding the information they should include in the bill of lading. This is usually one of the most labor-intensive tasks for those responsible for creating the bill of lading, so digitizing and automating this activity can speed up the overall process of creating the waybill;

4) Packing Lists (PL). These provide a detailed description of the contents of a shipment and serve to ensure the correct items are delivered to the right destination. Digitizing packing lists allows for automating the picking and packing process and reducing the risk of errors;

5) Delivery Note (DDT). A goods transport note or delivery note is a document issued by companies to justify or confirm the transfer of goods, raw materials, or the object of a commercial transaction from one place to another, even in the case of two separate units of the same company. Digitizing transport documents improves logistics processes overall. Choosing to digitize transport documents means a final shift away from paper to simplify and improve processes. Transport documents can physically travel with products or be sent electronically;

6) Invoices. Invoices are an important part of the billing and payment process, and converting them to digital form can help speed up payment cycles, reduce errors, and improve visibility of outstanding payments;

7) Pickup Requests. If a company receives pickup requests via email or PDF files (or other formats), this information is usually processed by a person to initiate the request and create a shipment in the company's transportation management system. This activity can be automated to optimize operations;

8) Air Waybill (AWB). An air waybill is the most important document issued by an airline directly or through its authorized agent. It is a non-negotiable transport document that covers the carriage of cargo from one airport to another. When accepting cargo, the freight forwarder acts on behalf of the airline whose air waybill was issued. Digitizing and automating AWBs can positively contribute to error-free processing of this document;

9) One-Time Quote Requests. For many companies, this can be very complex back-office work, as it is crucial to quickly read and respond to one-time quote requests to attract potential clients. Managing specific quote requests, even if they are sent via email with

audio text, using automated and digital methods can directly impact the number of requests processed and clients acquired;

10) Verified Gross Mass (VGM). This is a document that describes the weight of the cargo, including securing and reinforcement, as well as the tare weight of the container carrying the cargo. It is provided by the shipper to carriers and/or port terminal representatives before the closing date of the loading list. The ability to automatically obtain this information can be crucial for certain transport operations;

11) Cargo Manifest. Provides a summary list of all cargo on board a freight vessel, displayed under the vessel's name and identifying marks. Typically, a cargo manifest contains a list of all bills of lading with specified details and the total quantity of goods being transported. Therefore, as with the bill of lading, it is very important for companies to digitize and automate the processing of the manifest to improve the accuracy and speed of back-office activities.

Thus, by digitizing these and other logistics documents, companies can increase supply chain efficiency, reduce manual data entry errors, and gain real-time visibility into their operations.

The implementation of logistics management technologies requires a strategy tailored to the needs of each company. Defining clear goals, appropriate financial support, attracting and developing digital talents, as well as encouraging continuous improvement are key factors in achieving successful transformation. It is worth considering the benefits of forming integration relationships on a contractual or equity basis between consumers and producers by creating logistics networks, which enables the reduction of logistics and management costs [13].

Conclusions. The digitalization of logistics provides numerous advantages that allow optimizing the supply chain, increasing productivity and efficiency in all areas of the company's activities. The implementation of digital solutions achieves greater integration, traceability, and flexibility of processes, leading to significant improvements in logistics management. At the same time, digital transformation faces numerous challenges, including a shortage of skilled workforce and the need to enhance employees' digital skills.

Analysis of recent research indicates significant potential for digital technologies in logistics. The implementation of intelligent transportation systems, artificial intelligence, the Internet of Things, and blockchain can significantly improve supply chain management efficiency. This is confirmed by studies of foreign and domestic scientists who emphasize the importance of using advanced technologies to manage flows of raw materials, semi-finished products, and finished goods.

The practice of implementing logistics digitalization shows that main investments are directed towards cloud technologies, artificial intelligence, and machine learning. However, the results often do not meet the expectations of company executives, indicating the need for more in-depth analysis and strategy development to achieve long-term value.

Digitalization of logistics processes, particularly document digitization, contributes to increased accuracy and efficiency, cost reduction, and improved supply chain visibility. The implementation of automated document reading, intelligent data processing, and other advanced technologies allows avoiding errors, reducing information processing time, and focusing resources on the company's core activities.

Thus, logistics digitalization is a significant factor for modern companies seeking to increase their market competitiveness. It allows integration with other company departments, improves product tracking, accelerates customs procedures, optimizes transport costs, and increases flexibility in returns management. Despite the drawbacks accompanying this process, logistics digitalization is necessary to achieve sustainable development and

effective supply chain management in the modern world..

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