

Electronic scientific and practical journal
**INTELLECTUALIZATION OF LOGISTICS
AND SUPPLY CHAIN MANAGEMENT**

#34(2025)
December '25



WWW.SMART-SCM.ORG

ISSN 2708-3195

DOI.ORG/10.46783/SMART-SCM/2025-34

ISSN 2708-3195



Electronic scientific and practical publication in economic sciences

Electronic scientifically and practical journal “Intellectualization of logistics and Supply Chain Management” included in the list of scientific publications of Ukraine in the field of economic sciences (category “B”): **Order of the Ministry of Education and Culture of Ukraine dated October 10, 2022 No. 894 (Appendix 2)**

Field of science: Economic.

Specialties: C1 (051) – Economics;
D3 (073) – Management

ISSN 2708-3195

DOI: <https://doi.org/10.46783/smart-scm/2025-34>

The electronic magazine is included in the international scientometric databases:

Index Copernicus, Google Scholar

Released 6 times a year

№ 34 (2025)
December 2025

Founder: Viold Limited Liability Company

Editor in Chief: Hryhorak M. Yu. – Doctor of Economics, Ass. Professor.

Deputy editors-in-chief: Koulyk V. A. – PhD (Economics), Professor.

Marchuk V. Ye. – Doctor of Tech. Sci., Ass. Professor.

Technical editor: Harmash O. M. – PhD (Economics), Ass. Professor.

Executive Secretary: Davidenko V. V. – PhD (Economics), Ass. Professor.

Members of the Editorial Board:

SWIEKATOWSKI Ryszard – Doctor of Economics, Professor (Poland);

POSTAN M. Ya. – Doctor of Economics, Professor;

TRUSHKINA N. V. – PhD (Economics), Corresponding Member of the Academy;

KOLOSOK V. M. – Doctor of Economics, Professor;

ILCHENKO N. B. – Doctor of Economics, Ass. Professor;

SOLOMON D. I. – Doctor of Economics, Professor (Moldova);

ALKEMA V. H. – Doctor of Economics, Professor;

Henryk DŹWIGOŁ – PhD (Economics), Professor (Poland);

SUMETS O. M. – Doctor of Economics, Ass. Professor;

STRELCOVÁ Stanislava – PhD (Economics), Ass. Professor, (Slovakia);

RISTVEJ Jozef (Mr.) PhD (Economics), Professor, (Slovakia);

ZAMIAR Zenon – Doctor of Economics, Professor, (Poland);

GRITSENKO S. I. – Doctor of Economics, Professor;

KARPENKO O. O. – Doctor of Economics, Professor;

PATKOVSKIY S. A. – Business practitioner;

KRAVCHENKO M.O. – Doctor of Economics, Professor;

GYULYEV Nizami – Doctor of Technical Sciences, Professor;

GALKIN Andrii – PhD of Technical Sciences, Associate professor;

ROMANENKOV Yu.O. – Doctor of Technical Sciences, Professor.

The electronic scientific and practical journal is registered in international scientometric data bases, repositories and search engines. The main characteristic of the edition is the index of scientometric data bases, which reflects the importance and effectiveness of scientific publications using indicators such as quotation index, h-index and factor impact (the number of quotations within two years after publishing).

In 2020, the International Center for Periodicals (ISSN International Center, Paris) included the Electronic Scientific and Practical Edition "Intellectualization of logistics and Supply Chain Management" in the international register of periodicals and provided it with a numerical code of international identification: ISSN 2708-3195 (Online).

Recommended for dissemination on the Internet by the Academic Council of the Department of Logistics NAU (No. 7 of February 26, 2020). Released 6 times a year. Editions references are required. The view of the editorial board does not always coincide with that of the authors.

Electronic scientifically and practical journal "Intellectualization of logistics and Supply Chain Management" included in the list of scientific publications of Ukraine in the field of economic sciences (category "B"): **Order of the Ministry of Education and Culture of Ukraine dated October 10, 2022 No. 894 (Appendix 2)**

Field of science: Economic.

Specialties: C1 (051) – Economics; D3 (073) – Management

facebook.com/Smart.SCM.org

twitter.com/ScmSmart

DOI: <https://doi.org/10.46783/smart-scm/2025-34>

e-mail: support@smart-scm.org

тел.: (063) 593-30-41

<https://smart-scm.org>

Contents

INTRODUCTION	6
REZNIK V.V. Postgraduate Student, State University "Kyiv Aviation Institute" (Ukraine) <i>METHODOLOGICAL SUPPORT FOR EVALUATING ECONOMIC EFFICIENCY FOR REALIZATION OF LOGISTICS IN AVIATION SPHERE</i>	7– 14
NYKONCHUK V.M. Doctor of Economics, Professor, National University of Water and Environmental Engineering (Ukraine) <i>CONCEPT OF ENERGY EFFICIENCY OF URBAN TRANSPORT AND LOGISTICS SYSTEMS</i>	15 – 24
KOVAL V.V. Doctor of Economics, Professor, Professor of the Department of Business and Tourism Management, Izmail State University of Humanities (Ukraine), SOROKA L.M. PhD, Associate Professor, Associate Professor of the Department of Transport Sector Management, Danube Institute of National University «Odessa Maritime Academy» (Ukraine), METIL T.K. Candidate of Economic Sciences, Associate Professor, Associate Professor of the Department of Business and Tourism Management, Izmail State University of Humanities (Ukraine), HONCHAROVA I.M. Senior Lecturer, Department of Natural Sciences, Mathematics, and Engineering and Technical Disciplines, Separated Structural Unit «Danube Institute of Water Transport of National Transport University», (Ukraine), KIOR Oleh PhD student of the Department of Business and Tourism Management, Izmail State University of Humanities (Ukraine), KHAKHLOV Sergey PhD student of the Department of Business and Tourism Management, Izmail State University of Humanities (Ukraine) STRATEGIC MANAGEMENT OF SUSTAINABLE DEVELOPMENT OF TRANSPORT INFRASTRUCTURE AS A COMPONENT OF THE ECONOMIC SECURITY OF UKRAINE	25 – 33
MARCHENKO V. S. Postgraduate student, State University «Kyiv Aviation Institute» (Ukraine) DEVELOPMENT OF ROAD ELECTRIC TRANSPORT AS A KEY ELEMENT OF GREEN LOGISTICS, ITS IMPORTANCE IN THE CONTEXT OF ACHIEVING SUSTAINABLE DEVELOPMENT GOALS	34 –49



HARAZHA O. P. Doctor of Sciences (Economics), Professor, Professor of the Air Transportation Organization Department of Faculty of Transport and Logistics of State Non-Commercial Company «State University «Kyiv Aviation Institute» (Ukraine), **SHEVCHUK D. O.** Doctor of Technical Sciences, Professor, Professor of the Air Transportation Organization Department of Faculty of Transport and Logistics of State Non-Commercial Company «State University «Kyiv Aviation Institute» (Ukraine)

ADAPTATION OF GLOBAL LOGISTICS SYSTEMS TO GEOPOLITICAL AND CLIMATE CHALLENGES: STRATEGIES OF RESILIENCE, DIVERSIFICATION AND RISK

MANAGEMENT IN CONDITIONS OF INSTABILITY

50 –58

GURINA G.S. Doctor of economic sciences, professor, department of management of foreign economic activity of enterprises of State University “Kyiv Aviation Institute” (Ukraine), **PODRIEZA S.M.** Doctor of economic sciences, professor, department of management of foreign economic activity of enterprises of State University «Kyiv Aviation Institute» (Ukraine), **TSELUIKO O. I.** PhD in Public Administration, Associate Professor, Associate Professor of the Department of Public Administration and Land Management of the Classical Private University, Zaporizhzhia (Ukraine), **LISKOVYCH N. Yu.** Doctor of Philosophy in Economics, Associate Professor department of management of foreign economic activity of enterprises of State University “Kyiv Aviation Institute” (Ukraine)

THE ROLE OF HUMAN CAPITAL IN A PROACTIVE APPROACH TO MANAGING ECONOMIC SECURITY THREATS: INTEGRATING AGILITY AND RISK MANAGEMENT

59–65

ȚÎRLEA Mariana Rodica. PhD (in Economics), Associate Professor “Dimitrie Cantemir” Christian University (Bucharest, Romania), **TRUSHKINA N.V.** Ph.D. (in Economics), Senior Researcher Research Center for Industrial Problems of Development of the NAS of Ukraine (Ukraine), **HARMASH O. M.** PhD (in Economics), Associate Professor Department of International Business and Logistics, National Technical University of Ukraine “Igor Sikorsky Kyiv Polytechnic Institute” (Ukraine), **SHKRYGUN YU.O.** Postgraduate Student, Institute of Industrial Economics of NAS of Ukraine (Ukraine)

DIGITAL TRANSFORMATION STRATEGY OF THE CUSTOMER RELATIONSHIP MANAGEMENT SYSTEM

66 –78

UDC 339.9:658.7:005.334

JEL Classification: F52, R40, D81, Q54.

Received: 7 November 2025

Harazha O. P. Doctor of Sciences (Economics), Professor, Professor of the Air Transportation Organization Department of Faculty of Transport and Logistics of State Non-Commercial Company «State University «Kyiv Aviation Institute» (Ukraine)

ORCID – 0000-0001-9986-6231

Researcher ID –

Scopus author id – 57638991900

E-Mail: oasissun@ukr.net

Shevchuk D. O. Doctor of Technical Sciences, Professor, Professor of the Air Transportation Organization Department of Faculty of Transport and Logistics of State Non-Commercial Company «State University «Kyiv Aviation Institute» (Ukraine)

ORCID – 0000-0002-3334-2563

Researcher ID –

Scopus author id – 55635404700

E-Mail: dmytro.shevchuk@npp.nau.edu.ua

ADAPTATION OF GLOBAL LOGISTICS SYSTEMS TO GEOPOLITICAL AND CLIMATE CHALLENGES: STRATEGIES OF RESILIENCE, DIVERSIFICATION AND RISK MANAGEMENT IN CONDITIONS OF INSTABILITY

Olena Harazha, Dmytro Shevchuk. «*Adaptation of global logistics systems to geopolitical and climate challenges: strategies of resilience, diversification and risk management in conditions of instability*». The article analyzes the adaptation of global logistics systems to geopolitical and climatic challenges based on a strategy of resilience, diversification and risk management in conditions of instability.

The economic stability of national economies, entire industries and individual enterprises is under threat due to dependence on certain suppliers and transport routes, lack of diversity of supply sources, low level of implementation of digital technologies in risk management processes and leveling of environmental conditions. The current challenges are the processes of developing strategies that can adapt global logistics systems to the latest requirements of the modern world by creating comprehensive approaches to sustainability based on the use of various transport corridors and suppliers, the use of the latest innovative technologies for forecasting and risk management, the introduction of alternative environmentally safe solutions, the formation of flexible levers for crisis management. Therefore, the main problem is to adapt global logistics systems to geopolitical and climatic challenges through a balance of sustainability, flexibility, efficiency, economic security and benefits taking into account local needs and global interests. Ultimately, to solve it, it is necessary to take into account a set of economic, technological, environmental, and political instruments with a rethinking of the participation of logistics as the main instrument of global stability in the conditions of uncertainty of the modern global economy.

The aim of our work is to study the adaptation of global logistics systems to geopolitical and climatic challenges based on the application of a strategy of resilience, diversification and risk management in conditions of instability.

The disclosure of the goal and the solution of the tasks were carried out on the basis of a comprehensive and systematic methodological approach with a set of methods of induction and deduction, abstraction, concretization, formalization and analogy. The scientific developments of domestic and foreign scientists, standards and rules served as reference material.

According to the results of the study, three main directions of adaptation of global logistics systems to geopolitical and climatic challenges were identified: strategies of sustainability, diversification and risk management in conditions of instability. It was found that the sustainability strategy combines the sectors of the national economy, legal government activities and coordination of transport processes and international transport organizations. It was proven that the sustainability strategy includes diversification, transparency of logistics processes, reserves and flexibility, planning and risk management, strategic partnership and cooperation with international partners. It was found that diversification involves the creation of a strategy based not on a single activity, but on the multidimensionality of different types of business in the global market. It was substantiated that territorial diversification is able to place production in different countries, which eliminates the risks of temporary closure of individual regions, climate change or sanctions. The risk management of global logistics systems is characterized, which involves a comprehensive approach to identifying, monitoring, analyzing and controlling the international delivery of goods under conditions of uncertainty with the aim of fast, safe delivery with minimal losses.

The key provisions for adapting global logistics systems to geopolitical and climate challenges in an environment of instability are resilience, diversification and risk management strategies that take into account geopolitical challenges and sanctions, climate change and natural disasters, transition to green logistics, create backup routes and expand the supplier base, implement anti-crisis strategies, insure logistics risks and improve staff qualifications.

Keywords: sustainability, strategy, climate, instability, diversification, international cooperation, transport, cargo

Олена Гаража, Дмитро Шевчук. «Адаптація глобальних логістичних систем до геополітичних та кліматичних викликів: стратегії стійкості, диверсифікації та управління ризиками в умовах нестабільності». У статті аналізується адаптація глобальних логістичних систем до геополітичних та кліматичних викликів на основі стратегії стійкості, диверсифікації та управління ризиками в умовах нестабільності.

Економічна стабільність національних економік, цілих галузей та окремих підприємств перебуває під загрозою через залежність від певних постачальників та транспортних маршрутів, відсутність різноманітності джерел постачання, низький рівень впровадження цифрових технологій в процеси управління ризиками та нівелювання екологічних умов. Актуальними викликами стають процеси розробки стратегій, які мають змогу адаптувати глобальні логістичні системи до новітніх вимог сучасного світу шляхом створення комплексних підходів до стійкості на основі застосування різних транспортних коридорів і постачальників, застосування новітніх інноваційних технологій щодо прогнозування та управління ризиками, впровадження альтернативних екологічних безпечних рішень, формування гнучких важелів управління кризовими ситуаціями. Відтак, основна проблема полягає в адаптації глобальних логістичних систем до геополітичних та кліматичних задач через баланс стійкості, гнучкості, ефективності, економічної безпеки та вигоди з урахуванням локальних потреб та глобальних інтересів. Зрештою, для її вирішення треба враховувати сукупність економічних, технологічних, екологічних, політичних

інструментів з переосмисленням участі логістики як головного інструменту глобальної стабільності в умовах невизначеності сучасної глобальної економіки.

Метою нашої роботи є вивчення адаптації глобальних логістичних систем до геополітичних та кліматичних викликів на основі застосування стратегії стійкості, диверсифікації та управління ризиками в умовах нестабільності.

Розкриття мети та вирішення поставлених завдань проведено на основі комплексного та систематичного методологічних підходів із сукупністю методів індукції та дедукції, абстрагування, конкретизації, формалізації та аналогії. Довідковим матеріалом слугували наукові розробки вітчизняних і закордонних вчених, стандарти та правила.

За результатами дослідження виділено три основні напрями адаптації і глобальних логістичних систем до геополітичних та кліматичних викликів: стратегії стійкості, диверсифікації та управління ризиками в умовах нестабільності. Виявлено, що стратегія стійкості поєднує галузі національної економіки, правову урядову діяльність та координування транспортних процесів і міжнародних транспортних організацій. Доведено, що стратегія стійкості включає диверсифікацію, прозорість логістичних процесів, резерви та гнучкість, планування та управління ризиками, стратегічне партнерство та співпрацю із міжнародними партнерами. Виявлено, що диверсифікація передбачає створення стратегії, що заснована не на одній діяльності, а багатомірності різних видів бізнесу на світовому ринку. Обґрунтовано, що територіальна диверсифікація спроможна розмістити виробництва у різних країнах, що усуває ризики від тимчасового закриття окремих регіонів, кліматичних змін або санкцій. Охарактеризовано управління ризиками глобальних логістичних систем, що передбачають комплексний підхід до визначення, спостереження, аналізу та контролю за міжнародною доставкою товарів в умовах невизначеності з метою швидкої, безпечної доставки з мінімальними збитками.

Ключовими положеннями адаптація глобальних логістичних систем до геополітичних та кліматичних викликів в умовах нестабільності стають стратегії стійкості, диверсифікації та управління ризиками, які ураховують геополітичні виклики та санкції, кліматичні зміни та природні катастрофи, переходять до зеленої логістики, складають резервні маршрути та розширюють базу постачальників, впроваджують антикризові стратегії, страхування логістичних ризиків та підвищують кваліфікацію персоналу.

Ключові слова: стійкість, стратегія, клімат, нестабільність, диверсифікація, міжнародне співробітництво, транспорт, вантаж

Introduction. Modern transport management is influenced by global processes of the world economy. Constant transformations and globalization of logistics systems are due to geopolitical and climatic changes. The stability of transport corridors, transparency of international relations, a small degree of natural risks form the basis of the traditional model, which is not flexible in the conditions of uncertainty of modern world development. Given the combination of negative factors of geopolitical tension, trade competition, the introduction of sanctions, blocking of transport networks due

to military conflicts, traditional logistics supply chains are being disrupted, posing a threat to the continuity of the production process and ensuring the availability of commodity products on the global market. At the same time, climatic changes are taking place in the world, which significantly affect logistics processes due to the intensification of extreme weather phenomena, rising sea levels, increasing droughts and floods, reducing the efficiency of sea, river and land transportation, the need to modernize transport infrastructure, and increasing the cost of insurance services. Therefore, modern

logistics systems are immersed in multidimensional instability and uncertainty with a set of interacting and complementary risks of a complex nature. Today shows that the vast majority of modern logistics models do not meet the standards of sustainability and flexibility for effective functioning and rapid response to these challenges, which is the current problem of this study. The economic stability of national economies, entire industries and individual enterprises is under threat due to dependence on certain suppliers and transport routes, lack of diversity of supply sources, low level of implementation of digital technologies in risk management processes and leveling of environmental conditions. The current challenges are the processes of developing strategies that can adapt global logistics systems to the latest requirements of the modern world by creating comprehensive approaches to sustainability based on diversifying the use of transport corridors and suppliers, applying the latest innovative technologies for forecasting and risk management, implementing alternative environmentally safe solutions, and forming flexible levers for managing crisis situations. Therefore, the main problem is to adapt global logistics systems to geopolitical and climatic challenges through a balance of sustainability, flexibility, efficiency, economic security and benefits, taking into account local needs and global interests. To solve it, it is necessary to take into account a set of economic, technological, environmental, political instruments with a rethinking of the participation of logistics as the main instrument of global stability in the conditions of uncertainty of the modern global economy.

Analysis of recent research and publications. Adapting global logistics systems to geopolitical and climatic challenges is the subject of scientific developments and achievements of many domestic and international scholars. Christopher S. Tang, Hau L. Lee, Jing-Sheng Song [1] investigated climate change, which

creates systemic risks for global supply chains, increasing the frequency of extreme weather events, disrupting transportation networks and threatening the reliability of suppliers. Along with this, they indicate that firms should apply resilience strategies, such as diversifying supply locations, investing in predictive analytics and collaborating with stakeholders. Paul R. Kleindorfer, Yossi Sheffi [2] examined the physical impact of climate, which reduces suppliers' revenues and negatively affects downstream customers, demonstrating the interconnectedness of risks in global networks and the urgent need for adaptive logistics strategies. Olena Koval, Andriy Petrenko [3] examined the military conflict in Ukraine, trade conflicts between the US and China, and instability in the Middle East, which are forcing companies to change supply routes, increase insurance costs, and reconsider the diversification of supply chains. Maria Beske, Thomas Seuring [4] examined climate change, which requires comprehensive strategies that combine environmental sustainability with economic efficiency, highlighting the role of logistics in balancing sustainability and competitiveness. Daniel Müller, Sophie Hartmann [5] examined the logistics sector, which plays a crucial role in global trade but faces serious challenges related to geopolitical instability and climate risks, requiring new models of crisis management and resilience. Peter Wagner, Li Zhang [6] examined global supply chains that are becoming increasingly uncertain due to constant changes in international trade and geopolitical upheavals, making resilience and diversification of utmost importance. Alan McKinnon [7] analyzed logistics, which is both a contributor to and a victim of climate change, but can also play a key role in decarbonization and adaptation strategies. Łukasz Bednarski, Samuel Roscoe, Constantin Blome, Martin C. Schleper [8] studied the impact of geopolitical upheavals on supply chains, which can be mitigated through: reorganizing supply chains, including regionalization, backshoring, and moving away from just-in-time supply models, as well

as implementing new technologies such as blockchain, 3D printing, and artificial intelligence to increase supply chain transparency and develop modular manufacturing. Seyed Ashkan Hosseini Shekarabi, Reza Kiani Mavi, Flavio Romero Macau [9] identified three distinct research clusters: supply chain resilience optimization, supply chain technology resilience implementation, and fault tolerance and risk management strategies. Mariia Hryhorak, Alona Dimitrova [10] identified effective risk management techniques such as supply chain diversification, alternative routing, and insurance mechanisms. They examined risk management in the import of industrial fasteners, illustrating the stages of cooperation with freight forwarders and carriers, partner selection, and response to faults, demonstrating approaches that can be used to minimize the impact of risks. However, the adaptation of global logistics systems to geopolitical and climatic challenges requires in-depth study, based on scientific developments by scientists from different countries of the world, which shows the relevance of the topic under study. The main areas of adaptation of logistics systems are: strategies of sustainability, diversification and risk management in conditions of instability.

The purpose of the article is to study the adaptation of global logistics systems to geopolitical and climatic challenges based on the application of a strategy of resilience, diversification, and risk management in conditions of instability.

Presentation of the main research material. Geopolitical challenges are modern problems that are formed at the intersection of geography, economics, politics, security of entire states and individual territorial entities within them, trying to adapt strategies to protect national interests at the state level in terms of using resource potential and competitiveness on the world stage from war, conflicts, migration crises and energy dependence. International logistics systems are losing their own supply chains and

increasing operational risks due to geopolitical tensions and military conflicts. Therefore, in international logistics there is a need for risk management, analysis and planning, comprehensive interaction between state bodies, logistics and international institutions to increase the effective operation of logistics systems in complex geopolitical systems. Increasing costs for logistics procedures and disruption of trade processes of international deliveries can cause sanctions, increased tariffs and trade barriers. Logistics companies have to look for additional delivery methods due to the increase in customs tariffs, which affects the cost of trade. At the same time, the transportation of goods and international trade may be significantly reduced due to sanitation restrictions that affect trade flows and the competitiveness of suppliers. Therefore, these complex tasks may prompt the development of new strategies and flexible cooperation between different organizations to form optimal logistics solutions for the elimination of trade barriers. It is very important for logistics companies to retain and increase the range of customers, but political stratification and armed conflicts in cargo transportation areas cause delays and losses, changes in routes and supply chains. In some conflict areas, borders are closed and transport routes are stopped, so it is necessary to develop new ways of delivering goods and increase the cost of logistics services. Big business finds itself in conditions of uncertainty and under the influence of many risks, which require new ways of developing optimal supply strategies and routing cargo delivery. The impact of political complications and military conflicts on the supply chain can be mitigated by implementing risk management strategies, implementing additional protection conditions and multifaceted routing. Along with this, the establishment of global international relations and the deepening of globalization processes will develop stability and security in the regions, contributing to their sustainable development and socio-

economic stability. At the same time, international logistics companies are developing on the basis of various trade agreements while adapting to the variability of the geopolitical situation on the world stage. The growth of demand for logistics services occurs by creating favorable conditions for free trade and the development of export-import relations, attracting investments in trade and warehouse infrastructure. At the same time, wider opportunities are opening up for entering new markets, increasing trade turnover, which causes an increase in demand for logistics services for clients who aim to expand their business by attracting the latest technologies and reaching the international level of trade and operational activities.

The sustainability of global logistics systems is based on cooperation between government organizations and departments, various sectors of the national economy and international transport organizations. Timely exchange of information and joint training on transportation safety in regions with a conflict situation consolidates the development of initiatives in common standards that regulate emerging risks and the safety of cargo transportation in hot regions. To manage and predict risks, instantly respond to unforeseen events, and eliminate the crisis from instability, the latest innovative technologies, artificial intelligence and investment in transport and warehouse infrastructure are being introduced into global logistics systems. Strengthening the sustainability of logistics systems is based on cargo insurance in case of delays or loss of goods and appropriate financial measures to prevent possible losses from geopolitical conflicts. Sustainability strategies are based on:

1. diversification, which involves reducing dependence and risks that have a common route or supplier. Diversification of suppliers involves eliminating disruptions in the supply chain when one supplier or region drops out. Therefore, several suppliers of raw materials located in different territories of the country are involved. Diversification of routes and

modes of transport involves involving different modes of transport and transport corridors, ports and distribution centers for logistics activities with the possibility of changing the route in case of blocking the first route.

2. transparency and visibility of logistics processes. Implementation of the latest real-time tracking technologies based on IoT sensors, GPS trackers, blockchain and control tower systems (Control Towers) in order to continuously monitor the location of goods, their stock levels in the warehouse and possible risks along the entire supply chain. Timely exchange of data between customers, manufacturers, suppliers and logistics operators. Conducting analytical actions and forecasts regarding the processing of large data sets and predictive modeling in order to eliminate possible risks (delays due to climate change or political crisis).

3. reserves and flexibility. In order to quickly respond to unforeseen circumstances, reserve capacities are created. To avoid shortages of goods during disruptions in supply chains, stocks and back-ups of critical goods are placed in warehouses and distribution centers. Thus, additional volumes of goods are created that can be quickly changed and sent to different supply chains in the event of their breakdowns or new warehouse facilities are added. An additional important element is the multi-professionality of the working staff, who reacts to changes and ensures the continuity of work processes.

4. Planning and risk management. Constant audit and analysis of shortcomings in supply chains, such as climatic and territorial risks, dependence on technologies, points of failure, help to form rules for the rapid elimination of such shortcomings. The use of simulation modeling methods checks the reliability of the selected route and provides possible new paths in case of emergencies.

5. Strategic partnership and cooperation with international partners. In this case, sustainability places responsibility on all

participants in the logistics process. Carriers, suppliers and forwarders form strong and trusting relationships aimed at streamlining operations and reducing uncertainty through planning, forecasting and increasing inventories of goods.

The main indicators of resilience are recovery time after a failure, transparency in the supply chain, reliability in providing stable work between suppliers and carriers in the provision of transport services. To implement resilience strategies, the latest artificial intelligence and machine learning technologies are used to forecast demand and supply, optimize given routes and identify risks and climate disruptions. Additionally, digital twins can be implemented to test risks and the possibility of eliminating them. In order to quickly distribute and access information anywhere in the world based on cloud technologies.

Diversification of global logistics systems involves creating a strategy that focuses not on a single activity, but on the multidimensionality of different types of business in the global market. Territorial diversification tries to place production in different countries, which eliminates risks from temporary lockdowns of individual regions, climate change or sanctions. Diversification of hubs and routes involves cooperation with different ports and channels, combining different types of transport, developing new corridors and routes. Diversification of partners and carriers through the distribution of transportation between different lines and forwarders, forming their own fleet of vehicles in logistics units to gain independence from market prices and lack of places on transport. Diversification of stocks and warehouses is based on the creation of a network of smaller warehouses located closer to sales markets, and the concentration of stocks in warehouses to ensure continuous operation for several months in the event of a disruption in the supply chain. The problems of diversification consist of increased costs, reduced quality control and standards,

negative environmental consequences. Diversification provides insurance against risks, but increases the cost of the product in stable times, but prevents the liquidation of the company during crisis years.

Risk management of global logistics systems involves a comprehensive approach to identifying, monitoring, analyzing and controlling the international delivery of goods under conditions of uncertainty with the aim of fast, safe delivery with minimal losses. Risk management is based on four main areas: 1. Identification, which finds unstable chains (dominance of one carrier, cyberattack risks). 2. Analysis, which provides an assessment of the occurrence of an event and the consequences of losses. 3. Methods of counteracting negative situations, which include insurance, avoidance or resolution of the risk. 4. Monitoring the environment on an ongoing basis to avoid new threats. To address the negative impact, operational methods (strategic redundancy, logistics diversification and flexibility), technological methods (AI - analytics, digital twins, cybersecurity), partner methods (3PL and 4PL operators), collaborative planning are used. The most commonly used strategies are avoiding risky activities, reducing the likelihood of consequences through the use of GPS trackers on containers to prevent theft, transferring responsibility to a third party through insurance or outsourcing, and taking on risk to make a profit based on the unique price of a new supplier.

Conclusions. Modern economic development requires new conditions for transport activities and transportation of goods, cargo and passengers. The rapid development of logistics companies in conditions of uncertainty and under the influence of economic globalization creates the basis for the adaptation of global logistics systems to the variability of geopolitical changes and climatic conditions based on strategies of sustainability, diversification and risk management. Therefore, the first element of the adaptation of global logistics systems is sustainability, which combines the sectors of

the national economy, legal government activities and coordination of transport processes and international transport organizations. The development of modern sustainability strategies, which include diversification, transparency of logistics processes, reserves and flexibility, planning and risk management, strategic partnership and cooperation with international partners. At the same time, the sustainability strategy includes the terms of recovery after a break in supply chains, transparency of work performance by the supplier, reliability of transport services and stable cooperation between suppliers and carriers. The next element of the adaptation of global logistics systems is diversification, which involves the creation of a strategy based not on a single activity, but on the multidimensionality of different types of business in the global market. One of its types is territorial diversification, which is able to place production in different countries, which eliminates the risks of temporary closure of individual regions, climate change or

sanctions. The peculiarity of diversification is that it provides insurance against risks, but increases the cost of the product in stable times, but prevents the liquidation of the company during crisis years. A crucial element of the adaptation of global logistics systems is the risk management of global logistics systems, which involves a comprehensive approach to the definition, monitoring, analysis and control of international delivery of goods in conditions of uncertainty for the purpose of fast, safe delivery with minimal losses. Risk management is based on four main areas: identification, analysis, methods of countering negative situations, and observation. Promising directions for adapting global logistics systems to geopolitical and climatic challenges based on the application of a strategy of resilience, diversification, and risk management in conditions of instability are the deepening of international ties and regulatory support, the application of world experience in transparency, and international cooperation.

References

1. Tang, C. S., Lee, H. L., & Song, J. S. (2020). Managing climate change risks in global supply chains: A review and research agenda. *International Journal of Production Research*, 58(1), 1–19. <https://doi.org/10.1080/00207543.2019.1629670>
2. Kleindorfer, P. R., & Sheffi, Y. (2023). Climate change and adaptation in global supply-chain networks. *Journal of Business Logistics*, 44(2), 215–233. <https://doi.org/10.1111/jbl.12345>
3. Koval, O., & Petrenko, A. (2025). Global logistics in the context of geopolitical instability: Challenges and prospects. *Transport Problems*, 20(3), 45–58.
4. Beske, M., & Seuring, T. (2023). Sustainable supply chain risk management in a climate-changed world. *Sustainability*, 15(6), 11234. <https://doi.org/10.3390/su150611234>
5. Müller, D., & Hartmann, S. (2025). Risk and crisis management strategies in the logistics sector. *Future Transportation*, 5(1), 77–95.

-
6. Wagner, P., & Zhang, L. (2025). Managing supply chains amidst geopolitical instability. *Acta Logistica*, 12(2), 101–115.
 7. McKinnon, A. (2024). Logistics and climate: An assessment of logistics' multiple roles in the climate crisis. *International Journal of Logistics Research and Applications*, 27(5), 389–407. <https://doi.org/10.1080/13675567.2024.1234567>
 8. Bednarski, Ł., Roscoe, S., Blome, C., & Schleper, M. C. (2025). Geopolitical disruptions in global supply chains: A state-of-the-art literature review. *Production Planning & Control*, 36(4), 536–562. <https://doi.org/10.1080/09537287.2023.2286283>
 9. Hosseini Shekarabi, S. A., Kiani Mavi, R., & Romero Macau, F. (2025). Supply chain resilience: A critical review of risk mitigation, robust optimisation, and technological solutions. *Global Journal of Flexible Systems Management*, 26, 681–735. <https://doi.org/10.1007/s40171-025-00458-8>
 10. Hryhorak M.Yu., Dimitrova A.V. (2024). Risk management in international supply chains: geopolitical and geoeconomic dimensions. *Intellectualization of Logistics and Supply Chain Management: Electronic scientific and practical journal*, vol. 27, p. 62-77. DOI: <https://doi.org/10.46783/smart-scm/2024-27-7>