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Contents

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.

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LOGISTICS CLUSTER AS A WAY OF IMPLEMENTING A MULTISOURCING MODEL TO ENSURE THE LIVELIHOOD OF THE LOCAL COMMUNITY

Lesia Kostiuchenko, Volodymyr Marchuk, Oleg Harmash. "Logistics Cluster as a Way of Implementing a Multisourcing Model to Ensure the Livelihood of the Local Community". *In recent years, the living conditions of territorial communities in Ukraine promote the integration of organizations and enterprises in various fields. The cluster is a group of localized interdependent companies, equipment suppliers, components, specialized services, infrastructure, research institutes, universities and other organizations that complement and enhance each other's competitive advantages.*

Current common problems that hinder the normal functioning of local communities are: utilities and energy efficiency, investment climate and investment, public safety, problems of access to administrative services, communication problems between the leadership of the local community and local population, environmental issues.

Based on the results of the study of the internal environment of the united territorial community, the benefits of cluster approach and the benefits that can provide a multisourcing model, it is determined that the main problems that hinder the normal functioning of modern communities can be solved by forming a logistics cluster. The logistics cluster will allow to fully implement the multisourcing model of ensuring the livelihood of the local community. Such model of decision-making on the rational choice of source of supply from several alternatives will: improve the quality of supply management of goods / services; reduce the logistics cycle; reduce

supply costs; increase the reliability of supplies, etc. Thus, the formation of a logistics cluster at the level of ensuring the livelihood of the territorial community helps to strengthen the competitiveness of each of the participants. The main participants of the cluster are: production and logistics companies located in the most important centers of intersection and origin of goods and goods, directly involved in the process of providing services.

***Keywords**:* cluster, logistics cluster, internal environment of the cluster, multisourcing, united territorial community, problems of life of territorial communities.

Леся Костюченко, Володимир Марчук, Олег Гармаш. «Логістичний кластер як засіб реалізації мультисорсингової моделі забезпечення життєдіяльності територіальної громади». *Впродовж останніх років умови життєдіяльності територіальних громад в Україні сприяють інтеграції організацій і підприємств різних напрямів діяльності. Кластер являє собою групу локалізованих взаємозалежних компаній, постачальників устаткування, комплектуючих, спеціалізованих послуг, інфраструктури, науково-дослідних інститутів, вузів та інших організацій, які взаємодоповнюють і посилюють конкурентні переваги одне одного.*

Сучасними поширеними проблемами, які перешкоджають нормальній життєдіяльності територіальних громад, є такі: комунальні послуги та енергоефективність, інвестиційний клімат та залучення інвестицій, безпека громадян, проблеми доступу до адміністративних послуг, проблеми комунікації між керівництвом об'єднання територіальної громади та місцевого населення, екологічні проблеми.

На основі наведених результатів дослідження внутрішнього середовища об'єднаної територіальної громади, переваг кластерного підходу та переваг, які може надати модель мультисорсингу визначено, що головні проблеми, які перешкоджають нормальній життєдіяльності сучасних територіальних громад, можна вирішити шляхом формування логістичного кластера. Логістичний кластер дозволить повною мірою реалізувати мультисорсингову модель забезпечення життєдіяльності територіальної громади. Така модель прийняття рішень щодо раціонального вибору джерела постачання з декількох альтернативних дозволить: підвищити якість управління постачаннями товарів/послуг; скоротити логістичний цикл; зменшити витрати на постачання; підвищити надійність постачань тощо. Отже, формування логістичного кластера на рівні забезпечення життєдіяльності територіальної громади сприяє зміцненню конкурентоспроможності кожного з учасників. Основними учасниками кластера є: виробничі та логістичні підприємства, розташовані у найважливіших центрах перетину і зародження вантажів та товаропотоків, безпосередньо залучені до процесу надання послуг.

Ключові слова: кластер, логістичний кластер, внутрішнє середовище кластера, мультисорсинг, об'єднана територіальна громада, проблеми життєдіяльності територіальних громад.

Леся Костюченко, Владимир Марчук, Олег Гармаш. «Логистический кластер как средство реализации мультисорсинговой модели обеспечения жизнедеятельности территориальной общины». *На протяжении последних лет условия жизнедеятельности территориальных общин в Украине способствуют совместной деятельности организаций и предприятий различных направлений деятельности. Кластер представляет собой группу локализованных взаимосвязанных компаний, поставщиков оборудования, комплектующих, специализированных услуг, инфраструктуры, научно-исследовательских институтов, вузов и других организаций, взаимодополняющих и усиливающих конкурентные преимущества друг друга.*

Современными распространенными проблемами, препятствующими нормальной жизнедеятельности территориальных общин являются: коммунальные услуги и энергоэффективность, инвестиционный климат и привлечение инвестиций, безопасность граждан,

проблемы доступа к административным услугам, проблемы коммуникации между руководством объединения территориальной общины и местного населения, экологические проблемы.

На основе приведенных результатов исследования внутренней среды объединенной территориальной общины, преимуществ кластерного подхода и преимуществ, которые может предоставить модель мультисорсинга, определено, что главные проблемы, препятствующие нормальной жизнедеятельности современных территориальных общин, можно решить путем формирования логистического кластера. Логистический кластер позволит в полной мере реализовать мультисорсинговую модель обеспечения жизнедеятельности территориальной общины. Такая модель принятия решений по рациональному выбору источника поставки из нескольких альтернативных позволит: повысить качество управления поставками товаров/услуг; сократить логистический цикл; уменьшить расходы на поставку; повысить надежность поставок и т.д. Следовательно, формирование логистического кластера на уровне обеспечения жизнедеятельности территориальной общины способствует укреплению конкурентоспособности каждого из его участников. Основными участниками кластера являются: производственные и логистические предприятия, расположенные в важнейших центрах отправки и пересечения потоков товаров, непосредственно вовлеченные в процесс оказания услуг.

Ключевые слова: кластер, логистический кластер, внутренняя среда кластера, мультисорсинг, объединенная территориальная община, проблемы жизнедеятельности территориальных общин.

Introduction. Modern unstable in all respects living conditions of territorial communities in Ukraine contribute to the integration of organizations and enterprises in various fields. The formation of clusters has become widespread in recent years. It is worth noting that modern clusters have a complex multi-level organization; their structure is not standard; have different degrees of interaction (integration) of participants. The cluster is characterized by the presence of an internal competitive environment such as industry clusters (logistics, agriculture, socio-cultural, furniture, tourism, environmental, etc.). Thus, the cluster approach allows you to combine all the benefits of cooperation between companies and deepen their specialization, creating a significant multiplier effect in the region's economy.

Analysis of recent researches and publications. In the general sense, the cluster is a sectoral, territorial and voluntary association of business structures, who closely cooperate with scientific (educational) institutions, public organizations and local authorities in order to increase the competitiveness of their own products and promote economic development of the region. Thus, a cluster is a group of localized interdependent companies, equipment suppliers, components, specialized services, infrastructure, research institutes, universities and other organizations that complement and enhance each other's competitive advantages.

It is worth noting the following definitions of "cluster" [5]:

- voluntary association of entrepreneurs who work closely with research institutions and local authorities in order to increase the competitiveness of their own products and promote economic development of the region;
- geographical concentration of similar, related or additional enterprises with active channels for business transactions, communications and dialogue, sharing specialized infrastructure, labor markets and services and having common opportunities or threats;
- branch, territorial and voluntary association of business structures that closely cooperate with scientific (educational) institutions, public organizations and local authorities in order to increase the competitiveness of their own products and

promote economic development of the region;

- network of suppliers, producers, consumers, elements of industrial infrastructure, research institutes, interdependent in the process of creating added value;
- a group of interdependent enterprises and organizations located on the territory of the settlement or near it, which complement and strengthen each other's competitive advantages.

That is, according to the interpretation of Sokolenko S.I. [5], cluster approach allows you to combine all the benefits of cooperation between companies and deepen their specialization, creating a significant multiplier effect in the economy. Thus, modern clusters are an important form with a complex multi-level organization. The structure of economic clusters is not standard. They have different degrees of interaction of participants from relatively simple network type of associations to multilevel cooperative and competitive entities.

However, on the other hand, the attractiveness of the region for the location of foreign direct investment and determines its competitiveness, which depends on a number of factors favorable business and business climate [7]:

- legal factors (regulatory acts, permitting procedures, legislation, safety, etc.),
- technological factors (transport, roads, production, utilities, communications, telecommunications, research, science),
- commercial factors (sales networks, individualization, response, location, cost),
- socio-cultural factors (attitudes, behavior, traditions, social norms).

According to the authors [7], the ability to compete for flows of external resources primarily for foreign direct investment is embodied in ratings of ease of doing business, investment attractiveness of countries, markets, territories, global competitiveness index, etc. The article [6] names the main current problems that hinder the normal functioning of territorial communities, including the following:

- utilities and energy efficiency,
- investment climate and investment,
- public safety,
- problems of access to administrative services,
- communication problems between the leadership of the local community and local population,
- environmental (ecological) issues.

Ecological problems of territorial communities are investigated in the publication [2]. In accordance with the legislation of Ukraine on the provision of housing and communal services, the authority to process and dispose of household waste, as well as the establishment of tariffs for household waste management transferred to local governments, which led to demonopolization of the market for processing and disposal of household waste. However, the non-adoption at the legislative level of the introduction of extended liability of producers and importers of goods is currently hindering the development of the field of household waste management.

The purpose and objectives of the study. Analysis of the publications of the above authors and many other publications shows that views on the origin and content of the cluster approach of practitioners and academic experts do not differ significantly. However, the researched publications do not have enough information on the formation of logistics clusters at the level of territorial communities.

That is why the purpose of this study is to explore current trends in the development of logistics clusters at the level of territorial communities in Ukraine as a means of resource provision of the territorial community.

Basic material and results. Studies of current trends and living conditions of territorial communities in Ukraine have shown an intensive focus on clustering. Clusters are formed with the participation of different numbers of participants, but the

main goal of the cluster approach in all cases is to achieve a synergistic effect.

On the one hand, clustering is economic in nature, and on the other - involves the possible contribution of the state, business, education and science in the development of the individual, society and country. The Figure 1 shows the following principles of cluster cooperation defined by the Ukrainian Logistics Alliance [1].

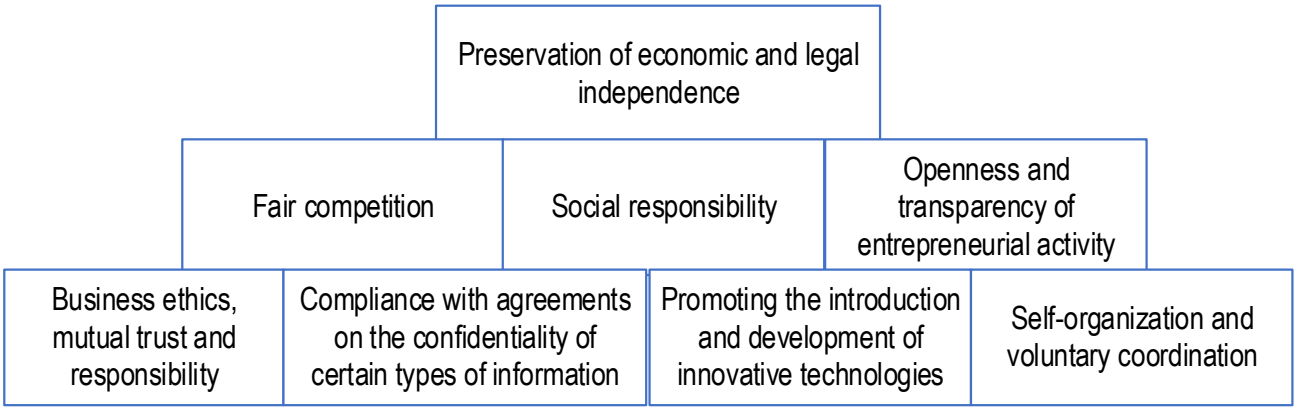

Figure 1 – Principles of cluster cooperation

Source: revised by the author on the basis of [1]

Thus we can highlight the following principles of cluster cooperation:

- close interaction between the participants of the logistics cluster, as well as with stakeholders;
- maximum use of innovations;
- intensifying the creation of new knowledge and ensuring their transfer;
- guarantee of ecological activity;
- development of human capital which is the bearer of key competencies of logistics companies;
- ensuring high quality services which is a source of competitive advantage and efficiency of the logistics cluster.

Adherence to the above principles of cluster cooperation by each partner will harmonize relations both within the cluster and between the cluster and the environment. Involvement of individual members of the community in its joint projects with other participants (investors, business, socio-cultural sector, waste sorting complexes, etc.) can be planned and designed in the Community Development Strategy. Thus directions of activity in formation of The Strategy can be various. For example, the creation of a dialogue platform for entrepreneurs, the creation of advisory boards, the creation of a transparent and effective base in local government, the development of open databases on land and real estate, the creation of an industrial park, increasing access to finance for entrepreneurs, namely affordable credit when the local self-government body acts as a guarantor or pays interest on loans, assistance in obtaining grants, appropriate rates of local taxes and fees, training of qualified personnel for entrepreneurs, development of an investment brand, etc. [8].

The study of the cluster with the participation of the territorial community from the middle allowed to identify the following characteristics:

1. Any territory resembles a diversified company operating in many markets (on the territory of the United Territorial Community (UTC) can be concentrated different activities, local governments are not always able to directly influence those activities that are developing in this territory).

2. Focus on the creation of public non-profit organizations (for example: the activities of the association of farmers in a certain area may be aimed at developing and agreeing tools and mechanisms to support farms by local governments).

3. UTC's image, its reputation in domestic and foreign circles of potential investors are the main factors in promoting various projects, the most important resource for establishing partnerships.

4. There are three target groups of the cluster or "consumers of territories" UTC: residents, enterprises, guests.

The components of the internal environment of UTC include (see Table 1):

Table 1 – Components of the internal environment of the United Territorial Community

The complex of resources of the UTC territory	Socio-economic condition of the territory of UTC	Situational factors within the "collective leader"
Natural resources and geographical location (mineral resources (fuel and energy, ores, chemical raw materials, natural building materials and non-metallic minerals) and biosphere resources (land, water and biological resources), etc.)	Can be assessed by groups of indicators that reflect: the finances of the territory of UTC	Affects the performance of management functions in UTC
Technological resources (a set of resources that allow to conduct production activities on the territory)	Economic and social well-being of the inhabitants of UTC	
Social resources (a set of relationships that arise between people inhabiting the territory, in the process of their interaction with each other)	The level of development of the productive and non-productive spheres on the territory of UTC, etc.	

Source: Source: revised by the author on the basis of [6, 7, 8]

The Figure 2 shows the scheme of interaction of cluster participants such as elements of the internal and external environment of the cluster in the cell UTC.

The optimal combination of internal and external resources of suppliers is sourcing. According to the author, this is a key process in community management, where the leading link is the concept of total living expenses. It is advisable to give preference to the concept of logistics outsourcing, which is to address the feasibility of using their own capabilities and resources to perform certain logistics functions that can be entrusted to an external partner. However, in the current context of rapid change, it is important to make quick and efficient decisions about sources of supply regardless of which sourcing model is used. Safety (reliability and stability) of supplying is at the top of the list. Therefore, it is valuable to quickly decide on the optimal source of supply as the optimal combination of internal resources of the company and the resources of external suppliers.

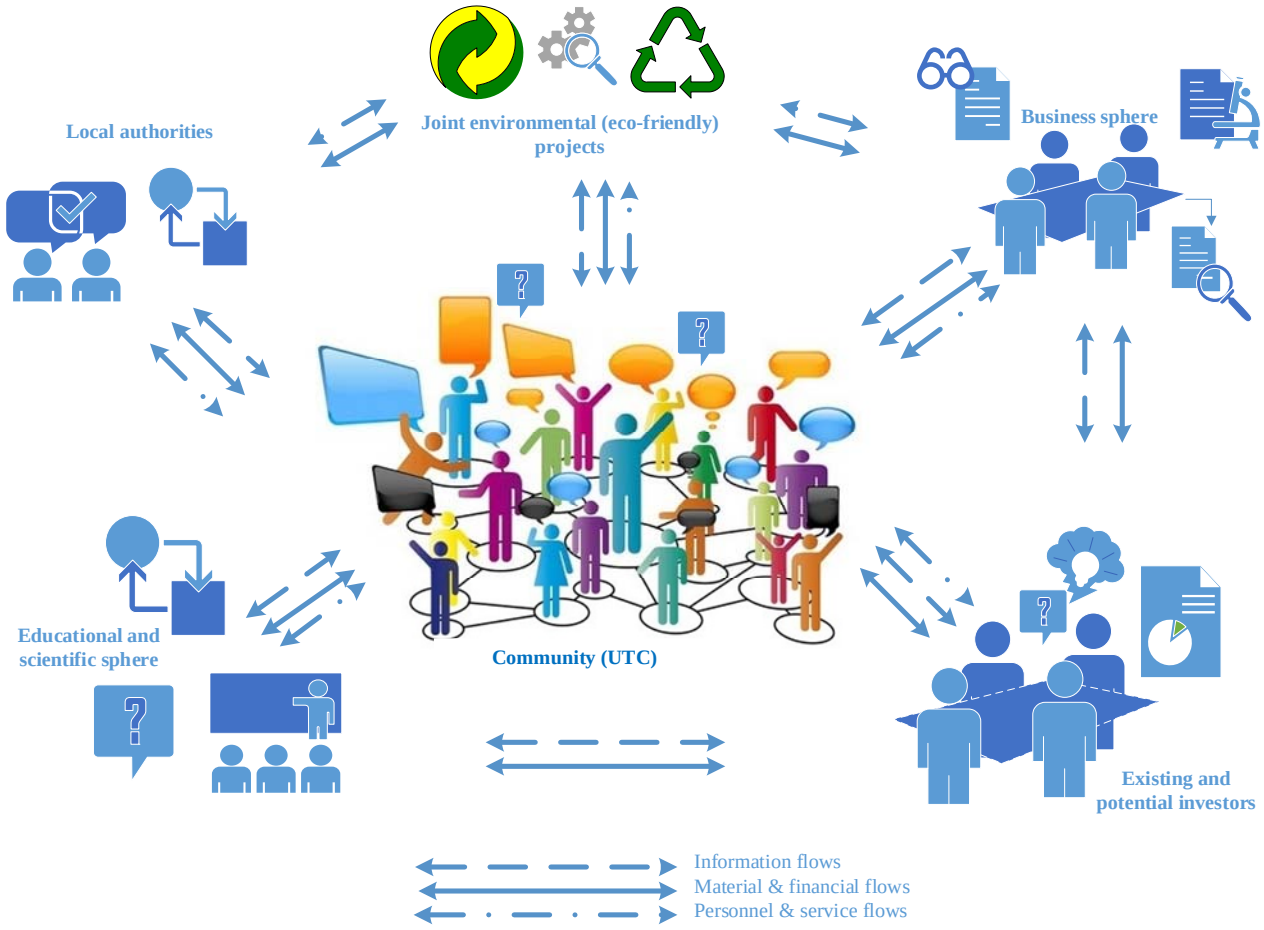

Figure 2 – Relationships between elements of the internal and external environment of the cluster on the territory of the United Territorial Community
Source: revised by the author

Multisourcing is a type of outsourcing that many companies use in conditions of frequent change. The multisourcing model involves the use of several different suppliers of the same product at different times (the decision depends on the level of security), as well as the efficient use of internal sources of supply of goods / services. A more detailed study of this subject is described in the author's article [3]. Thus, the decision on the rational choice of source of supply from several alternatives is based on the achievement of the following main objectives: to improve the quality of supply management; reduce the logistics cycle; reduce supply costs; increase the reliability of supplies, etc. Thus, it can be assumed that the formation of a logistics cluster in the UTC environment can be a means of implementing a multisourcing model to ensure the viability of the local community.

Based on the processed information materials and described above model we can give the following definition of a logistics cluster. Thus, the logistics cluster is a form of integration of participants in the logistics services market, which will provide maximum synergy based on optimization, innovation and coordination of economic interests of all participants in the supply chain (see Figure 3).

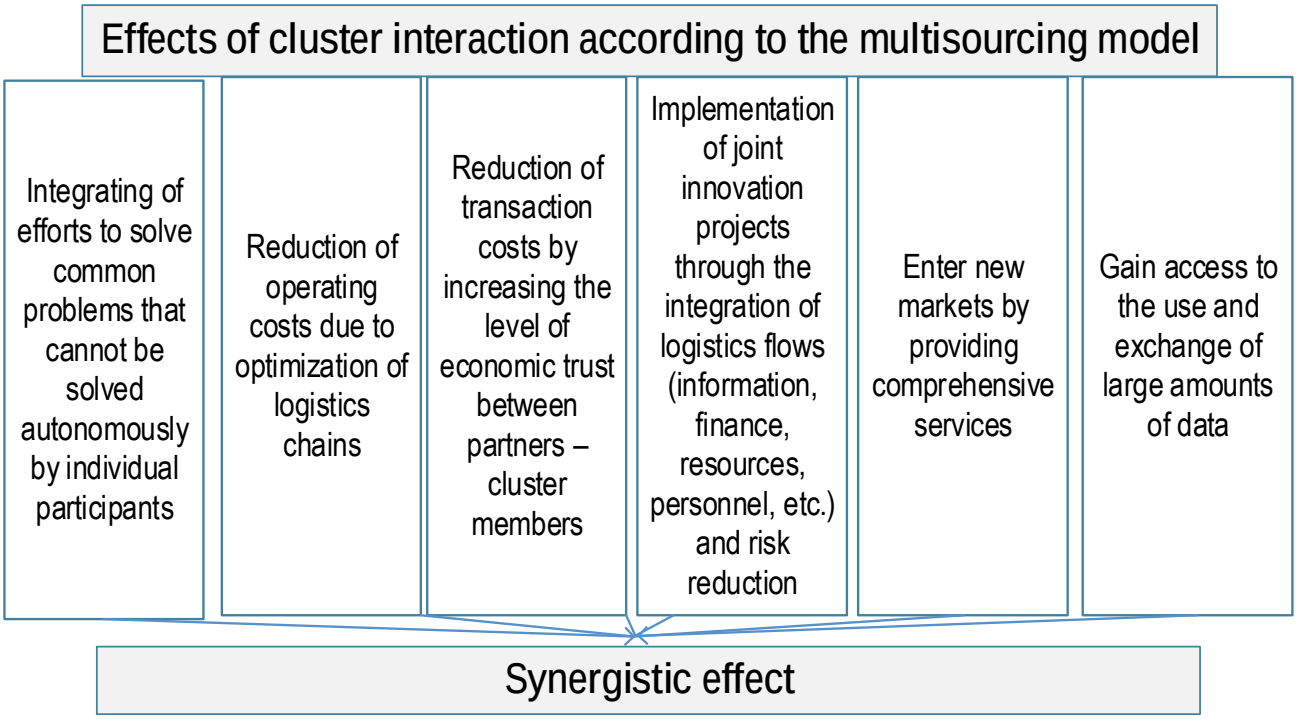

Figure 3. – Elements of synergetic effect from cluster interaction of participants according to the multisourcing model

Source: revised by the author on the basis of [1]

C**onclusions.** Based on the results of UTC's study of the internal environment, the advantages of the cluster approach and the advantages that the multisourcing model can provide, we conclude that the main problems that hinder the normal functioning of modern local communities can be solved by forming a logistics cluster. That is, deciding on the rational choice of source of supply from several alternatives allows to achieve the following main goals: to improve the quality of supply management of goods / services; reduce the logistics cycle; reduce supply costs; increase the reliability of supplies, etc. Thus, the formation of a logistics cluster to ensuring the livelihood of the territorial community helps to strengthen the competitiveness of each of the participants. The main participants of the cluster are: production and logistics companies located in the most important centers of intersection and origin of goods directly involved in the process of providing services.

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MODERN CHALLENGES OF AIR TRANSPORT: SAFETY, REGULATIONS, OPERATIONS AND INFRASTRUCTURE

Dmytro Bugayko, Yuliya Ierkovska, Fariz Aliyev. Danylo Bugayko. «Modern challenges of air transport»: safety, regulations, operations and infrastructure». *Openness to the negative consequences of global, regional and national financial crises, the tragic events associated with the activities of terrorist organizations and, first of all, the global COVID 19 pandemic lead to the fact that the issues of efficiency and economic feasibility are among the priorities in solving the challenge of maintaining an appropriate safety level. In fact, the philosophy of aviation safety is changing from an understanding of its purely technical and technological component and extends to determining the severity of risks to property, life and health of people, the environment, financial security, and legal liability of enterprises have shocked aviation transport. At the same time, harmonization, integrity and operational interchangeability of the industry's integrated security system are achieved; the worldwide exchange of safety-related information; global systemic hazards are identified and eliminated at an early stage. The effective management of aviation safety requires a systematic approach to the development of policies, procedures and recommended practices. Safety management*

integrates different types of aviation activities into a single whole. The main challenges of Ukrainian air transport in the context of the globalization of the air transportation market are the annexation of Crimea, the armed conflict in the east of Ukraine, the tragedy of the Boeing-777 of Malaysian Airlines, the closure of airspace over the vast territory of Ukraine, the refusal to fly over the Russian Federation, the tragedy of the Boeing-737 of International Airlines Ukraine" in Iran and, to a greater extent, the COVID-19 pandemic. These challenges are reflected in almost all macro, meso and microeconomic indicators of the activity and infrastructure of air transport. However, air transport is not only an open system, but also an adaptive system. Modern challenges of its activities indicate the need to develop strategic scenarios and develop a mechanism for institutional support for further sustainable development, taking into account the dynamic external environment, constant changes in the structure and intensity of threats and uncertainties.

***Keywords**:* air transport, safety, regulation, operation, infrastructure, hazards, risks.

Дмитро Бугайко, Юлія Єрковська, Фаріз Алієв, Данило Бугайко. "Сучасні виклики авіаційного транспорту: безпека, регулювання, експлуатація, інфраструктура". *Відкритість до негативних наслідків загальносвітових, регіональних і національних фінансових криз, трагічні події, пов'язані з діяльністю терористичних організацій та, в першу чергу, всесвітня пандемія COVID 19 призводять до того, що саме питання ефективності та економічної доцільності є одними з пріоритетних при вирішенні завдання підтримки відповідного рівня безпеки. Фактично філософія безпеки авіації змінюється з розуміння її суто технічної та технологічної складової і поширюється на визначення ступеня тяжкості ризиків для майна, життя і здоров'я людей, довкілля, фінансової безпеки і юридичної відповідальності галузі авіаційного транспорту. При цьому досягаються гармонізація, цілісність і експлуатаційна взаємозамінність системи комплексної безпеки галузі; поширюється у всесвітньому масштабі обмін інформацією, пов'язаною з безпекою польотів; виявляються й усуваються глобальні системні джерела небезпеки на ранньому етапі. Для ефективного управління безпекою авіації необхідний системний підхід до розроблення політики, процедур і рекомендованої практики. Управління безпекою об'єднує різні види авіаційної діяльності в єдине ціле. Основними викликами авіаційного транспорту України в умовах глобалізації ринку авіаційних перевезень є анексія Криму, збройний конфлікт на сході України, трагедія Боїнгу-777 Малайзійських авіаліній, закриття повітряного простору над великою територією України, відмова від польотів над Російською Федерацією, трагедія Боїнгу-737 Міжнародних авіаліній України в Ірані та, в найбільшій мірі, пандемія COVID-19. Ці виклики знайшли відображення практично в усіх макро, мезо та мікроекономічних показниках діяльності та інфраструктури авіаційного транспорту. Однак авіаційний транспорт – не тільки система відкритого типу, але й адаптивна система. Сучасні виклики його діяльності вказують на необхідність розробки стратегічних сценаріїв та відпрацювання механізму інституційного супроводу його подальшого сталого розвитку з урахуванням динамічного зовнішнього середовища, постійної зміни структури та інтенсивності загроз та факторів невизначеності.*

Ключові слова: авіаційний транспорт, безпека, регулювання, експлуатація, інфраструктура, загрози, ризики.

Дмитрий Бугайко, Юлия Ерковская, Фариз Алиев, Даниил Бугайко. "Современные вызовы авиационного транспорта: безопасность, регулирование, эксплуатация, инфраструктура". *Открытость негативным последствиям общемировых, региональных и национальных финансовых кризисов, трагические события, связанные с деятельностью террористических организаций и, в первую очередь, всемирная пандемия COVID 19 приводят к тому, что именно вопросы эффективности и экономической целесообразности являются одними из приоритетных при решении задачи поддержания соответствующего уровня безопасности. Фактически философия*

безопасности авиации изменяется с понимания ее чисто технической и технологической составляющей и распространяется на определение степени тяжести рисков для имущества, жизни и здоровья людей, окружающей среды, финансовой безопасности, юридической ответственности предприятий отрясли авиационного транспорта. При этом достигаются гармонизация, целостность и эксплуатационная взаимозаменяемость системы комплексной безопасности отрасли; распространяется во всемирном масштабе обмен информацией, связанной с безопасностью полетов; выявляются и устраняются глобальные системные источники опасности на раннем этапе. Для эффективного управления безопасностью авиации необходим системный подход к разработке политики, процедур и рекомендуемой практики. Управление безопасностью объединяет разные виды авиационной деятельности в единое целое. Основными вызовами авиационного транспорта Украины в условиях глобализации рынка авиационных перевозок являются аннексия Крыма, вооруженный конфликт на востоке Украины, трагедия Боинга-777 Малазийских авиалиний, закрытие воздушного пространства над обширной территорией Украины, отказ от полетов над Российской Федерацией, трагедия Боинга-737 «Международных авиалиний Украины» в Иране и, в большей степени, пандемия COVID-19. Эти вызовы нашли отражение практически во всех макро, мезо и микроэкономических показателях деятельности и инфраструктуры авиационного транспорта. Однако авиационный транспорт – не только система открытого типа, но и адаптивная система. Современные вызовы его деятельности указывают на необходимость разработки стратегических сценариев и отработки механизма институционального сопровождения дальнейшего устойчивого развития с учетом динамической внешней среды, постоянного изменения структуры и интенсивности угроз и факторов неопределенности.

Ключевые слова: авиационный транспорт, безопасность, регулирование, эксплуатация, инфраструктура, угрозы, риски.

Introduction. The development of world civil aviation is accompanied by continuous technological progress and requires constant improvement in the field of control and reduction of the impact of hazardous factors in its activities. However, despite all efforts to prevent failures and errors, they will still take place, and one hundred percent safety cannot be achieved. No human activity and no artificial system can be guaranteed to be completely safe, ie free from risks. Global cooperation in international civil aviation is an effective tool for reducing risks.

The article is a logical continuation of a number of publications devoted to the development of air transport safety, regulations, operations and infrastructure aspects of Ukrainian scientists G. Suslova [1], D. Bugayko [1 – 7], Y. Kharazishvili [2, 3 – 5], M. Hryhorak [3 – 4], Y. Ierkovska [6 – 7], O. Ovdiienko [4], V. Marchuk [4], V Lyashenko[5], V Sokolovskiy [5], V Baranov[5], Mariia Bahrii [7], Polish scientists (Z. Zamiar [3]), Azerbaijan Scientists F. Aliev [7], and scientists of other countries. Statistical data for aviation transport risk assessment are taken from the following statistical sources of the State Statistics Service [8], Ministry of Infrastructure [9], the Civil Aviation Authorities [10] and National Bureau for the Investigation of Aviation Accidents and Incidents with Civil Aircraft of Ukraine [11].

The purpose of the article is to provide structural analysis of modern challenges of air transport by the aspects of safety, regulations, operations and infrastructure.

Presentation of the main results. *Problems of aviation safety regulation in the conditions of globalization.*

One of the main goals of the world's leading and regional civil aviation organizations is to create a single global aviation safety system in deep cooperation of ICAO member states on global support for International Civil Aviation Organization (ICAO) Standards and Recommended

Practices (ICAO SARPS), which are constantly updated within 19 Annexes to the Chicago Convention 1944. ICAO's strategic objectives are to ensure flight safety, aviation and environmental safety.

An important step in the development of global civil aviation safety was the decision to enter into force in November 2013 19 of the Annex to the Chicago Convention on Safety Management. The new Annex contains the concept of the State Aviation Safety Program and 8 critical elements of the safety oversight system. The application covers activities in the field of general and commercial aviation, strengthens the role of the state in maintaining safety at the state level, emphasizing the concept of joint work on safety in all areas, coordination with air navigation service providers.

The new application is being developed in two stages. The first step is to summarize the existing safety management provisions contained in the 6 Annexes in one new Annex 19. However, the main safety management provisions have been moved from the following annexes:

- Annex 1 - Issuance of certificates to aviation personnel;
- Annex 6 - Aircraft Operations,
  - Part I - International Commercial Air Transport - Aircraft,
  - Part II - International General Aviation - Aircraft and
  - Part III - International Flight - Helicopters;
- Annex 8 - Airworthiness of aircraft;
- Annex 11 - Air Traffic Services;
- Annex 13 - Investigation of aviation incidents and incidents;
- Annex 14 - Aerodromes, Volume I - Design and operation of aerodromes.

Adoption of Program 6, Part II, Annex 5 and Part III, Annex 1 - Control over flight safety by operators, as well as repetition of Annex 13, Appendix E - Legal framework for protection of information on systems for collecting and processing safety data. The main difference between the provisions of Annex 19 was the extension of the conceptual framework of the safety management system to the level of organizations responsible for the design or manufacture of aircraft, raising safety standards, expanding the powers of the state safety oversight system to the level of all service providers. Particular attention is paid to the collection, analysis of safety data, their exchange and legal principles of information protection in systems for the collection and processing of safety data. In 2013, the third edition was published, and in 2019 - the fourth edition of Document 9859 "Aviation Safety Management Guide", which is based on the conceptual provisions of the State Aviation Safety Program and Flight Safety Management System [12].

The second stage of the development of Annex 19 is devoted to the definition of extended standards and recommended practices in the field of a single aviation safety management system. Also international cooperation in the field of aviation safety at the following levels:

– cooperation within the framework of corporate associations (for example, the International Air Transport Association (IATA), the American Air Transport Association (ATA) and the Civil Aviation Navigation Services Organization (CANSO);

– cooperation within national and international aviation associations (for example, the National Business Aviation Association (NBAA), the European Business Aviation Association (EBAA), etc.);

– cooperation within the framework of international federations of national associations (for example, the International Federation of Airline Pilots Associations (IFALPA) and the International Federation of Air Traffic Controllers Associations (IFATCA);

– activities of international aviation security bodies (for example, the World Aviation Safety Fund (FSF) and the International Society for Aviation Safety Researchers (ISASI));

– cooperation within industry / government groups (eg the Commercial Aviation Safety Group (CAST) and the Pan

American Commercial Aviation Safety Group (PAST));

– holding large aviation safety forums with the participation of aircraft and equipment manufacturers.

A positive aspect of such cooperation is the development of a comprehensive approach to solving the problem of aviation safety, taking into account not only purely technical and technological issues, but also identifying commercial and economic risks for various actors in the air transport market. This is extremely important, because in the context of globalization there is a steady trend of weakening state support for aviation enterprises. In such conditions, the world's civil aviation focuses on achieving three main goals - safety, efficiency and economic feasibility. Problems in achieving any of them threaten the effective functioning of the industry. At the same time openness to the negative consequences of global, regional and national financial crises, tragic events related to the activities of terrorist organizations (such as September 11, 2001 in the US), natural disasters, volcanic eruptions, tsunamis, earthquakes, etc., and, first of all, the global pandemic COVID 19 lead to the fact that the issue of efficiency and economic feasibility is one of the priorities in solving the problem of maintaining an appropriate level of safety. In fact, the philosophy of aviation safety changes from understanding its purely technical and technological component and extends to determining the severity of risks to property, human life and health, environment, financial security and legal responsibility of the airline, its image and public confidence in it. At the same time harmonization, integrity and operational interchangeability of the system of complex safety of the branch are achieved; the exchange of safety-related information is spreading worldwide; global systemic sources of danger are identified and eliminated at an early stage. Effective aviation safety management requires a systematic approach to the development of policies, procedures and recommended practices. Safety management combines different types of aviation activities into a single whole [1].

The conceptual step in the development of the national aviation safety system of Ukraine was the signing by the Cabinet of Ministers of Ukraine of the Order of June 16, 2021 № 656-r "On approval of the State Safety Program." The State Safety Program includes the following national approaches to ensuring the following aspects of air transport safety development:

– State policy and objectives in the field of aviation safety,

– Management of risk factors for aviation safety at the state level

– Commitments to the safety management system

– Investigation of aviation incidents and incidents

– Safety management & risk management

– Ensuring aviation safety at the state level

– Obligations to supervise

– Effectiveness of flight safety at the state level

– Promotion of flight safety issues at the state level [13].

Aviation safety is an important component of the concept of general national security, personal security, public safety and transport safety from external and internal hazards. With advanced risk management, hazards monitoring and precautionary measures are carried out in a complex in the areas of aviation economic development planning, aviation infrastructure, economic security, aviation security and their quintessential aviation safety.

Global trends in aviation infrastructure development.

Civil aviation statistics show that the growth of the main indicators of air traffic doubles every fifteen years. This is much more dynamic than the growth of most other industries. Since 1960, the demand for passenger, luggage, freight and postal

services has been steadily increasing. The development of technological progress and related investments are combined and make it possible to multiply the output of the aviation industry by a factor of more than 30. Such expansion of air transport is extremely beneficial for global economic growth, especially for world production (global GDP). In real terms, it multiplied more than five times over the same period [14].

However, a structural analysis of air traffic volumes suggests that the dynamic growth of air traffic is consistently opposed by recessionary cycles. The aviation industry is an open system that is affected by a wide range of technical, natural, human and economic threats. For its part, it itself is a generator of significant threats to the environment. Among the most significant threats to civil aviation in the history of development are the following:

- fuel crisis (1973),
- the war between Iran and Iraq (1981),
- the Gulf War (1991),
- The Asian crisis (1997-1998),
- the terrorist attack in the United States on September 11 (2001),
- SARS (2003),
- global recession (2008) [15].

However, one of the most threatening challenges in the history of air transport is the spread of a new deadly infection, COVID-19, which effectively leads to a quarantine blockade of entire regions and a sharp reduction in or ban on air traffic. The COVID-19 pandemic in 2020 significantly affected the volume of air passenger traffic. In the industry as a whole, the volume of passenger-kilometers decreased by 65.9% compared to the same period last year. In total, about 1.5 billion passenger trips have been made during this time. The decline in air passenger traffic in 2020 has been the largest since global passenger-kilometers began to be tracked since 1950. As noted above, since 1990, long-term average industrial growth has been around 5% per year. The pandemic also had a significant impact on economic activity, with deteriorating business conditions, declining consumer confidence, a sharp decline in corporate incomes and employment, which ultimately directly affected the individual living standards of the majority of the world's population. In fact, world GDP has fallen by 3.6% and this is the biggest drop in recent history. But the decline in passenger-kilometers was much greater than GDP due to tight controls on air travel, particularly internationally. The COVID-19 crisis has made domestic aviation markets more resilient than international ones. This is because internal controls are generally less stringent than external ones. Thus, in 2020, the volume of global domestic passenger-kilometers decreased by 48.7% year on year, while for international passenger-kilometers it was a decline of 75.6%. The market share of the world's domestic passenger-kilometers also increased from 36% of industry passenger-kilometers in 2019 to 54% in 2020 [16].

Planning of economic development of air transport of Ukraine.

Ukraine is an aviation state that has a full cycle of development and serial production of aircraft, commercial operation of civil aviation, training and retraining of professionals for the industry. Statistical data on the activities of air transport in Ukraine should be studied in two phased periods from 2010 to 2019 and separately for 2020. The first stage allows to make analytical conclusions on the main trends in the development of air transport of the state, which indicate its stable development during this period. 2020 is the year of force majeure of the global pandemic COVID-19, which poses a critical threat to its further development and has a negative impact on almost all indicators of the industry. During the period from 2010 to 2019, the share of air transport in the country's export-import operations is gradually increasing: in 2019, exports amounted to USD 1,419.7 million. USA (15.5% of total exports of transport services). However, the COVID-19 pandemic in 2020 reduced air transport exports by 43.5% to $ 802.2 million. USA. A

similar trend is observed with regard to imports of air transport - 757.8 million dollars. USA (48.6% of total imports of transport services). The impact of the COVID-19 pandemic in 2020 reduced air transport exports by 58% to $ 319.9 million. USA [8]. Statistical data on exports and imports of transport services and air transport services in the period from 2010 to 2020 are given in Table 2.1. .3. Planning of economic development of air transport of Ukraine. Ukraine is an aviation state that has a full cycle of development and serial production of aircraft, commercial operation of civil aviation, training and retraining of professionals for the industry. Statistical data on the activities of air transport in Ukraine should be studied in two phased periods from 2010 to 2019 and separately for 2020. The first stage allows to make analytical conclusions on the main trends in the development of air transport of the state, which indicate its stable development during this period. 2020 is the year of force majeure of the global pandemic COVID-19, which poses a critical threat to its further development and has a negative impact on almost all indicators of the industry. During the period from 2010 to 2019, the share of air transport in the country's export-import operations is gradually increasing: in 2019, exports amounted to USD 1,419.7 million. USA (15.5% of total exports of transport services). However, the COVID-19 pandemic in 2020 reduced air transport exports by 43.5% to $ 802.2 million. USA. A similar trend is observed with regard to imports of air transport - 757.8 million dollars. USA (48.6% of total imports of transport services). The impact of the COVID-19 pandemic in 2020 reduced air transport exports by 58% to $ 319.9 million. USA [8]. Statistical data on exports and imports of transport services and air transport services in the period from 2010 to 2020 are given in Table 1.

Table 1 - Export-import of transport services and air transport services

Years	2010	2014	2015	2016	2017	2018	2019	2020
Exports (million USD)								
Transport services	7835,2	6102,0	5263,2	5300,5	5861,4	5851,4	9109,9	4988,4
Aviation services	1181,9	1071,2	8536,1	8828,4	1091,7	1221,6	1419,7	802,2
Imports (million USD)								
Transport services	1178,9	1376,5	1153,3	9892,7	1213,1	1464,8	1559,1	1061,0
Aviation services	447,6	431,0	466,9	357,5	452,4	695,7	757,8	319,9

Source: State Statistics Service of Ukraine [8].

Air transport is an effective catalyst for investment. Thus, in just 8 years (2014-2020), even in conditions of political instability, armed conflict in eastern Ukraine and the global pandemic COVID-19, the industry was attracted 7.14 billion UAH. capital investment [8]. Statistical data on capital investments of enterprises of economic activities and air transport in the period from 2010 to 2020 are given in table 2.

These results are particularly relevant given the tendency that the total number of people involved in air transport is not very large (16 thousand people, or 2.5% of the total population involved in transport) [8]. At the same time, it is conceptual that air transport accumulates highly educated people with a professional level of competence with one of the highest levels of the average monthly salary, which is almost twice the average monthly salary in transport.

Table 2 - Capital investments of enterprises of economic activities and air transport

Years	2010	2014	2015	2016	2017	2018	2019	2020
In actual prices, UAH billion								
Transport services	19,59	15,50	18,70	25,11	37,94	50,08	43,79	34,88
Aviation services	0,62	0,41	0,65	0,62	1,30	1,53	1,77	0,86

Source: State Statistics Service of Ukraine [8].

However, as mentioned above, air transport has not only direct but also indirect and inductive effects. That is, it creates jobs in various sectors of the economy and contributes to achieving synergistic social effects of sustainable development of the national economy. Statistical data on the average number and average monthly salary of full-time employees of enterprises of economic activities and air transport in the period from 2010 to 2020 are given in table 3.

Table 3 - The average number and average monthly wages of full-time employees of enterprises of economic activities and air transport.

Years	2010	2014	2015	2016	2017	2018	2019	2020
Average number of full-time employees, thousand								
Transport services	824,3	731,0	661,4	659,9	655,2	648,4	635,1	625,8
Aviation services	11,1	7,3	6,9	7,1	8,2	8,1	16,2	16,0
Average monthly salary of full-time employees, UAH								
Transport services	2658	3768	4653	5810	7688	9860	11704	11951
Aviation services	6774	11967	18470	24688	31088	35651	27300	21685

Source: State Statistics Service of Ukraine [8].

The dynamics of changes in the number of aircraft fleets reflects not so much quantitative as qualitative change. The dynamic decrease in the number of aircraft in the period from 2010 to 2015 is mainly due to the gradual decommissioning of economically unprofitable and obsolete aircraft manufactured during the Soviet era. In fact, in the period from 2016 to 2019, the airlines optimized the total fleet of about 200 aircraft. Unfortunately, the impact of the COVID-19 pandemic in 2020 optimized the fleet of Ukrainian airlines by 25% to 155 [8]. Statistical data on the fleet of aircraft of Ukrainian airlines in the period from 2010 to 2020 are given in table 4.

Table 4 - Fleet of Ukrainian airlines

Years	**2010**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Aircraft, helicopters								
Aircraft, helicopters	395	222	196	208	200	205	205	155

Source: State Statistics Service of Ukraine [8].

This trend was offset by the renewal of the park with the latest economic and environmental modifications of Western-made aircraft (Boeing, Airbus, Embraer, etc.). At the same time, the airlines did not aim to maximize the fleet of aircraft, but to implement the policy of optimizing the fleet of aircraft and mass departure from direct purchases of their own aircraft to the development of leasing agreements. This is

one of the protective mechanisms to respond to sudden changes in demand for transportation.

Trends in the development of aviation infrastructure in Ukraine.

Similarly to the statistics on the activities of air transport, the trends in the development of aviation infrastructure in Ukraine should be studied in two stages in the period from 2010 to 2019 and separately for 2020. The first stage allows to make analytical conclusions about the main trends in the development of aviation infrastructure in Ukraine. 2020 is a year of force majeure - the global pandemic COVID-19, which poses a critical threat to the development of global, regional, international and national aviation infrastructure.

Passenger air transportation of Ukraine.

As well as at the global level, there is a direct dependence of production indicators on the negative impact of external factors that caused a significant decline in passenger traffic, namely: annexation of Crimea, armed conflict in eastern Ukraine, downing of Boeing 777 Malaysia Airlines, airspace closure over a large territory of Ukraine, refusal to fly over the Russian Federation, etc. However, civil aviation is not only an open system, but also an adaptive system. And these significant recessionary trends have been overcome through the development of infrastructure, taking into account the newly created constraints. During the period from 2010 to 2019, there was a 2.3-fold increase in passenger traffic from 6 to 14 million passengers per year. The corresponding trend is inherent in the volume of passenger turnover, which has increased almost threefold during this period from 11 to 30.3 billion passenger-km.

During 2020, domestic airlines (29 - in 2019) performed 56% of commercial flights less than in 2019 - 45.3 thousand against 103.3 thousand flights in 2019 (Civil Aviation Service, 2020) [10].

Statistical data on the volume of passenger traffic and passenger turnover in transport and air transport of Ukraine in the period from 2010 to 2020 are given in table 5.

Table 5 - Transportation of passengers and passenger turnover in transport and air transport of Ukraine

Years	2010	2014	2015	2016	2017	2018	2019	2020
Passenger traffic (million passengers)								
Transport services	6845	5902	5167	4854	4648	4487	4262	2570
Aviation services	6	6	6	8	10	12	14	14
Passenger turnover (billion passenger km)								
Transport services	130,0	106,3	97,0	102,2	99,4	104,4	107,2	49,0
Aviation services	11,0	11,6	11,4	15,5	20,4	25,9	30,3	10,1

Source: State Statistics Service of Ukraine [8]

One of the most serious crises in the world aviation, related to the COVID-19 pandemic, is currently underway. The air transport economy is extremely vulnerable to external factors, as it has a number of fixed cost items that must be paid regardless of standard or force majeure conditions. First of all, it is the payment of lease payments for the fleet of aircraft, which now consists mainly of leased aircraft. Airlines pay an average of 10 thousand dollars. US per day for leasing one Boeing 737-800 or Airbus 320. Thus, the daily leasing budget of UIA may be about 300 thousand dollars. USA, SkyUp and Wind Roses - up to 100 thousand dollars. USA. To these costs are added other fixed items: salaries of employees, insurance, maintenance of airworthiness of aircraft, etc. Under such conditions, it is advanced risk management and consolidation measures by the state,

aircraft or helicopter operators, approved maintenance organizations, organizations responsible for the design or manufacture of aircraft and leasing organizations, air traffic service providers, certified aerodrome operators, approved training organizations can hinder the overall destruction of the industry. Thus, the specificity of open systems is the phenomenon of the "domino effect". If organizations of one segment disappear from the market, it systematically affects the performance of others, as well as the overall synergy of the industry. The dynamics of the volume of passenger traffic by air transport of Ukraine in the period up to 2020 is shown in Fig. 1.

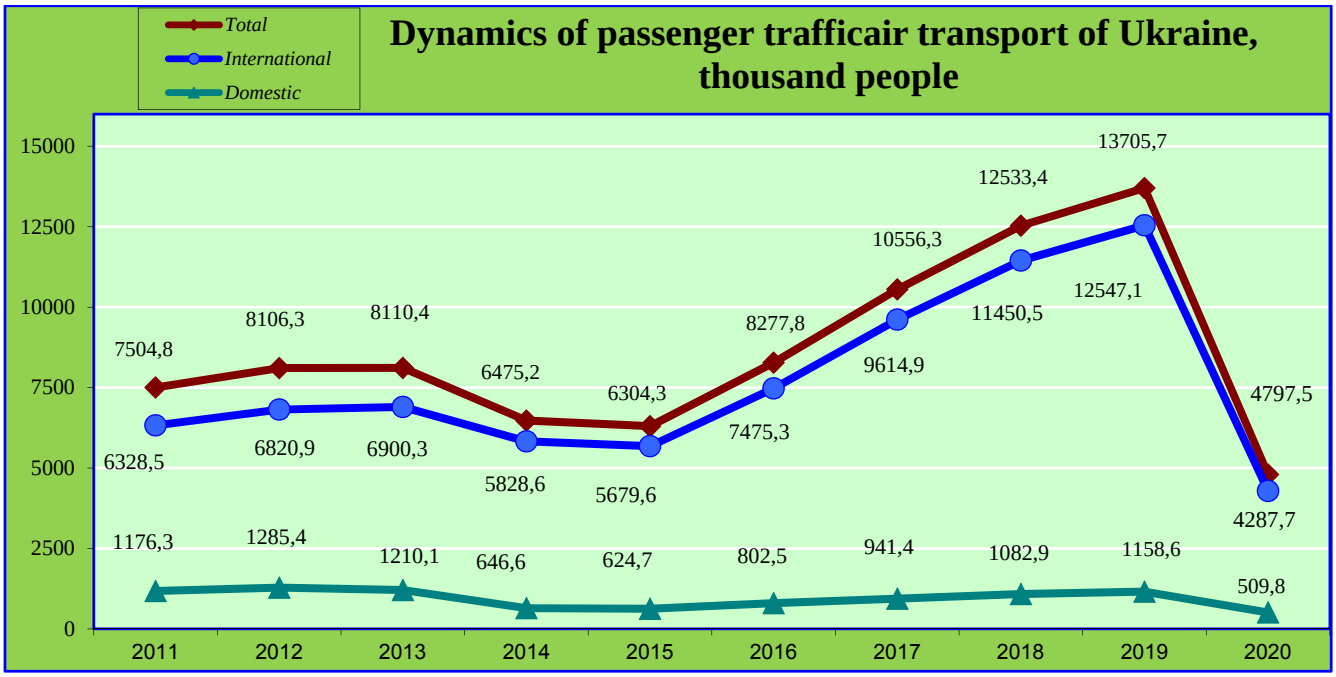

Figure 1 - Dynamics of passenger air transport in Ukraine in the period up to 2020
Source: State Aviation Service, 2020 [10]

At the same time, the volume of passenger traffic by air transport of Ukraine returned to approximately the level of 2006 - 2007, when the mentioned figure was 4208.3 thousand and 4928.6 thousand people. in accordance. Passenger traffic was provided by 14 domestic airlines during the year. The largest volumes were performed by Ukraine International Airlines, Skype, Azur Air Ukraine and Wind Rose, which accounted for almost 98 percent of the total passenger traffic of Ukrainian airlines.

Freight air transportation of Ukraine.

In contrast to passenger traffic, the volume of cargo and mail by air of Ukraine during the COVID-19 pandemic did not decrease critically. According to the results of 2020, the volumes of cargo and mail transportation by air transport of Ukraine amounted to 88.3 thousand tons (for 2019 - 92.6 thousand tons). In total, 20 domestic airlines performed cargo and mail transportation in the reporting year. Leaders of cargo transportation are ZetAvia Airlines, Antonov ATP, Maximus Airlines, Ukraine International Airlines, Constanta and Skype. In the reporting year, these airlines performed almost 90 percent of the total cargo and mail traffic. It should be noted that the majority of freight traffic has traditionally been charter flights to other countries under UN humanitarian and peacekeeping programs, as well as under contracts and agreements with other customers [10]. Statistical data on the volume of cargo transportation and cargo turnover on transport and air transport of Ukraine in the period from 2010 to 2020 are given in table 6.

Table 6 - Cargo transportation and cargo turnover on transport and air transport of Ukraine

Years	2010	2014	2015	2016	2017	2018	2019	2020
Cargo transportation (million tons)								
Transport services	1765	1623	1474	1543	1582	1643	1579	1641
Aviation services	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1
Cargo turnover (billion tkm)								
Transport services	418,7	353,6	334,7	344,2	364,2	361,3	355,0	313,2
Aviation services	0,4	0,2	0,2	0,2	0,3	0,3	0,3	0,3

Source: State Statistics Service of Ukraine [8]

Airport operations.

One of the most vulnerable adverse effects of the COVID-19 pandemic. elements of the aviation infrastructure system of Ukraine were airports. Unlike airlines, which are able to drastically reduce their fleet of aircraft during critical periods by quickly abandoning leasing operations, airports do not have the ability to quickly reduce their own operating costs. The number of aircraft sent and arrived in 2020 amounted to 94 thousand (against 201.2 thousand in the previous year). At the same time, passenger traffic through the airports of Ukraine decreased by 64.4 percent, freight traffic - by 13.3 percent and amounted to 8664.5 thousand people and 52.2 thousand tons, respectively. During the year, commercial flights of domestic and foreign airlines served 19 Ukrainian airports and airfields [10]. In fig. 2 shows the volume of passenger traffic through the airports of Ukraine in the period from 2011 to 2020.

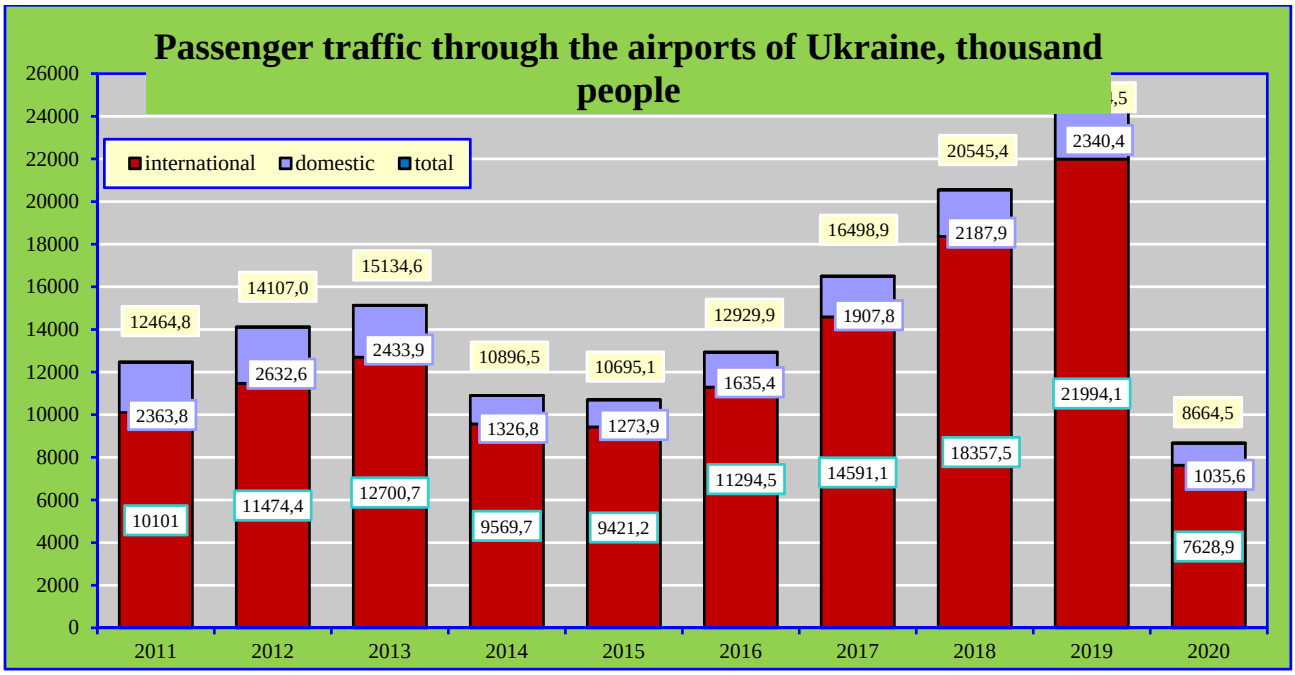

Figure 2 - The volume of passenger traffic through the airports of Ukraine in the period from 2011 to 2020

Source: State Aviation Service, 2020 [10]

Today, 97 percent of all passenger traffic and almost 99 percent of mail and cargo traffic are concentrated in 6 major airports (Kyiv (Boryspil), Lviv, Kyiv (Zhulyany), Odessa, Kharkiv and Zaporizhia) [10]. In fig. 3 shows the share of leading airports in the total volume of passenger traffic through the airports of Ukraine.

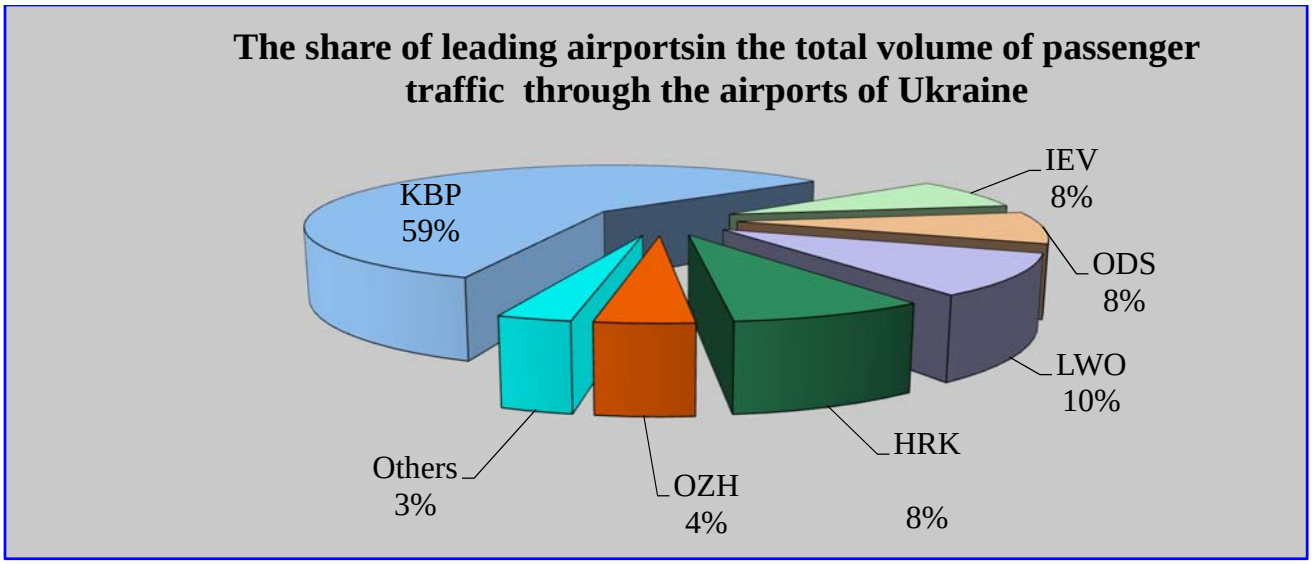

Figure 3 - Share of leading airports in total passenger traffic through Ukrainian airports
Source: State Aviation Service, 2020 [10]

According to the results of the year, the number of passengers served by the main airport of the country Kyiv (Boryspil) decreased compared to the previous 2019 by 66.2 percent. Passenger traffic through Kyiv (Zhulyany) airport decreased by 73.1 percent, Lviv - by 60.4 percent, Odessa - by 58.8 percent, Kharkiv - by 50.8 percent, Zaporozhye - by 24.9 percent [10].

Aviation works.

In 2020, aviation companies processed 287.8 thousand hectares of agricultural land, the number of flights during aviation works amounted to 10.8 thousand hours (in 2019 - 360.7 thousand hectares and 8.8 thousand hours, respectively) [10].

Air traffic service of Ukraine.

During the reporting year, UkSATSE provided 142,000 flights with air navigation services, compared to 335.4 thousand a year earlier. The number of flights operated by airplanes and helicopters of Ukrainian airlines decreased by 54.7 percent, foreign airlines - by 59.1 percent [10].

C**onclusions.** Thus, the main challenges of Ukraine's air transport in the globalization of the air transportation market are the annexation of Crimea, the armed conflict in eastern Ukraine, the downing of Malaysia Airlines Boeing 777, the closure of airspace over Ukraine, the refusal to fly over the Russian Federation, the downing of Boeing 737 of Ukraine International Airlines in Iran and, to the greatest extent, the COVID-19 pandemic. These challenges are reflected in virtually all macro, meso and microeconomic performance indicators and main performance indicators of air transport infrastructure. However, air transport is not only an open system, but also an adaptive system. The current challenges of its activities indicate the need to develop strategic scenarios and work out a mechanism for institutional support for its further sustainable development, taking into account the dynamic external environment, constant changes in the structure and intensity of hazards and uncertainties.

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RELATIONSHIP BETWEEN TRANSPORT INFRASTRUCTURE EXPENDITURES AND COSTS AND TRANSPORT INDICATORS - AN OVERVIEW OF EUROPEAN AND UKRAINIAN SITUATION

Lidia Savchenko. «Relationship between transport infrastructure expenditures and costs and transport indicators - an overview of European and Ukrainian situation». *Quality of transport infrastructure determines the quality of the provision of services for the transportation of goods and passengers. The infrastructure sector is a guarantee of efficiency, mobility and uninterrupted economic activity. However, the high quality of the transport infrastructure implies significant and long-term investments. According to a McKinsey research report, to support sustainable economic growth in the world in line with forecasts for 2030, it is necessary to cover the need for additional investment of $ 3.3 trillion annually, equivalent to 3.8% of world GDP.*

The purpose of this work is to analyze the existing European approach to assessing transport infrastructure expenditures and costs, their impact on transport performance at the country level, as well as trends in Ukrainian policy regarding the support and development of road infrastructure.

Transport infrastructure costs include the investment in new infrastructure, the cost of upgrading the existing infrastructure, the cost of maintaining the infrastructure, and the operating costs to enable the use of the transport infrastructure. Directive 2011/76 / EU prescribes that the weighted average infrastructure charges should be linked to construction costs, as well as the costs of operation, maintenance and development of the corresponding infrastructure network.

The official Eurostat data of investment and O&M costs of transport infrastructure based on the citizenship principle was taken for this study, namely:

- the number of ton-kilometers traveled per year;

- the volume of investments in road infrastructure per year;

- the amount of funds for the maintenance of road infrastructure per year.

The indicators were taken for countries of the EU for which statistics were available for 2016 and 2019. According to the study, the effect of investments in transport infrastructure is strongly manifested both in the same year and affects subsequent years in terms of the volume of annual transport work. That is, an increase in investment in road infrastructure clearly has a positive effect on the volume of transport work performed. On the other hand, the volume of investments in the EU infrastructure brings a much greater positive effect than funds for road maintenance.

Thus, the experience of developed countries shows a positive relationship between investment in the maintenance and construction of transport infrastructure and economic performance of the state. Part of the research was devoted to the study of the impact of investments in road infrastructure of Ukraine on the example

of the global Ukrainian infrastructure project "Big Construction". It is projected that in 2024, thanks to road works under the Big Construction, Ukraine's GDP will be 4.4% higher than GDP in 2020. But, as the research shows, good transport infrastructure is a necessary, but not a sufficient condition for growth. "Big Construction" project in Ukraine does not show any positive effect on the volume of performed internal transport work now. The reasons may lie both in more long-term effect from improving the infrastructure, and in the facts of corruption and theft of funds allocated for the project.

***Keywords**:* road transport, road infrastructure, infrastructure expenditures and costs, transport indicators, infrastructure investment, correlation, "Big Construction" project.

Лідія Савченко. " Зв'язок витрат на транспортну інфраструктуру та транспортних показників - огляд європейської та української ситуації ". *Якість транспортної інфраструктури визначає якість надання послуг із перевезення вантажів та пасажирів. Інфраструктурний сектор є гарантією ефективності, мобільності та безперебійної економічної діяльності. Проте висока якість транспортної інфраструктури передбачає значні та довгострокові інвестиції. Згідно з дослідницьким звітом McKinsey, для підтримки сталого економічного зростання у світі відповідно до прогнозів на 2030 рік необхідно покривати потребу в додаткових інвестиціях у розмірі $3,3 трлн щорічно, що еквівалентно 3,8% світового ВВП.*

Метою даної роботи є аналіз існуючого європейського підходу до оцінки витрат на транспортну інфраструктуру, їх впливу на транспортну ефективність на рівні країни, а також тенденції української політики щодо підтримки та розвитку власної дорожньої інфраструктури.

Витрати на транспортну інфраструктуру включають інвестиції в нову інфраструктуру, витрати на модернізацію існуючої інфраструктури, витрати на утримання інфраструктури та експлуатаційні витрати, необхідні для використання. Причому, Директива 2011/76/ЄС вимагає пов'язувати середньозважені платежі за інфраструктуру з вартістю будівництва, а також з витратами на експлуатацію, технічне обслуговування та розвиток відповідної інфраструктурної мережі.

Для цього дослідження було взято офіційні дані Євростату про інвестиції та витрати на експлуатацію та технічне обслуговування транспортної інфраструктури, а саме:

- кількість тонно-кілометрів, пройдених протягом року;

- обсяг інвестицій у дорожню інфраструктуру на рік;

- обсяг коштів утримання дорожньої інфраструктури на рік.

Показники взяті для країн ЄС, за якими була наявна статистика за 2016 та 2019 роки. Згідно з дослідженням, ефект від інвестицій у транспортну інфраструктуру сильно проявляється як у тому ж році, так і впливає на наступні роки за обсягом річної транспортної роботи. Тобто збільшення інвестицій у дорожню інфраструктуру однозначно позитивно впливає на обсяг виконуваної транспортної роботи. З іншого боку, обсяг інвестицій в інфраструктуру ЄС приносить набагато більший позитивний ефект, ніж кошти на утримання доріг.

Таким чином, досвід розвинених країн показує позитивний зв'язок між інвестиціями в утримання та будівництво транспортної інфраструктури та економічними показниками держави. Частину дослідження було присвячено вивченню впливу інвестицій у дорожню інфраструктуру України на прикладі глобального українського інфраструктурного проекту «Велике будівництво». Прогнозується, що у 2024 році завдяки дорожнім роботам у рамках «Великого будівництва» ВВП України буде на 4,4% вище за ВВП 2020 року. Але, як показують дослідження, хороша транспортна інфраструктура є необхідною, але не достатньою умовою зростання. Проект «Велике будівництво» в Україні в даний час не надає позитивного впливу на обсяг внутрішніх

транспортних робіт. Причини можуть бути як у довгостроковому ефекті від поліпшення інфраструктури, так і в фактах корупції та розкрадання коштів, виділених на проект.

Ключові слова: автомобільний транспорт, дорожня інфраструктура, інфраструктурні витрати, транспортні показники, інфраструктурні інвестиції, кореляція, проект «Велике будівництво».

Лидия Савченко. Взаимосвязь затрат и расходов на транспортную инфраструктуру и транспортных показателей - обзор европейской и украинской ситуации". *Качество транспортной инфраструктуры определяет качество оказания услуг по перевозке грузов и пассажиров. Инфраструктурный сектор является гарантией эффективности, мобильности и бесперебойной экономической деятельности. Однако высокое качество транспортной инфраструктуры предполагает значительные и долгосрочные инвестиции. Согласно исследовательскому отчету McKinsey, для поддержки устойчивого экономического роста в мире в соответствии с прогнозами на 2030 год необходимо покрывать потребность в дополнительных инвестициях в размере $3,3 трлн ежегодно, что эквивалентно 3,8% мирового ВВП.*

Целью данной работы является анализ существующего европейского подхода к оценке расходов и затрат на транспортную инфраструктуру, их влияния на транспортную эффективность на уровне страны, а также тенденции украинской политики в отношении поддержки и развития дорожной инфраструктуры.

Затраты на транспортную инфраструктуру включают в себя инвестиции в новую инфраструктуру, затраты на модернизацию существующей инфраструктуры, затраты на содержание инфраструктуры и эксплуатационные расходы, необходимые для использования транспортной инфраструктуры. Директива 2011/76/ЕС предписывает увязывать средневзвешенные платежи за инфраструктуру со стоимостью строительства, а также с расходами на эксплуатацию, техническое обслуживание и развитие соответствующей инфраструктурной сети.

Для этого исследования были взяты официальные данные Евростата об инвестициях и затратах на эксплуатацию и техническое обслуживание транспортной инфраструктуры, а именно:

- количество тонно-километров, пройденных за год;

- объем инвестиций в дорожную инфраструктуру в год;

- объем средств на содержание дорожной инфраструктуры в год.

Показатели взяты для стран ЕС, по которым имелась статистика за 2016 и 2019 годы. Согласно исследованию, эффект от инвестиций в транспортную инфраструктуру сильно проявляется как в том же году, так и влияет на последующие годы по объему годовой транспортной работы. То есть увеличение инвестиций в дорожную инфраструктуру однозначно положительно сказывается на объеме выполняемой транспортной работы. С другой стороны, объем инвестиций в инфраструктуру ЕС приносит гораздо больший положительный эффект, чем средства на содержание дорог.

Таким образом, опыт развитых стран показывает положительную связь между инвестициями в содержание и строительство транспортной инфраструктуры и экономическими показателями государства. Часть исследования была посвящена изучению влияния инвестиций в дорожную инфраструктуру Украины на примере глобального украинского инфраструктурного проекта «Большая стройка». Прогнозируется, что в 2024 году благодаря дорожным работам в рамках Большой стройки ВВП Украины будет на 4,4% выше ВВП 2020 года. Но, как показывают исследования, хорошая транспортная инфраструктура является необходимым, но не достаточным условием роста. Проект «Большая стройка» в Украине в настоящее время не оказывает положительного влияния на объем выполняемых внутренних транспортных работ.

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Причины могут крыться как в более долгосрочном эффекте от улучшения инфраструктуры, так и в фактах коррупции и хищения средств, выделенных на проект.

Ключевые слова: автомобильный транспорт, дорожная инфраструктура, инфраструктурные расходы и затраты, транспортные показатели, инфраструктурные инвестиции, корреляция, проект «Большая стройка».

Introduction. Transport infrastructure is a necessary element of logistics all over the world. In general, the quality of infrastructure determines the quality of the provision of services for the transportation of goods and passengers, and in particular - the speed of transportation, comfort while driving, the safety of cargo and vehicles, etc. However, the high quality of the transport infrastructure implies significant and long-term investments. For developing countries, such financial investments in transport infrastructure are often unattainable. Countries with developed economies can afford to maintain a high level of highways, railways, etc., in particular, due to public-private partnerships and the introduction of the toll roads practice.

Road transport is a key contributor to economic development and integration. Its flexibility and capabilities make it indispensable to development strategies and integration processes. For example, in the European Union road transport is a main enabler of integration both through well connected infrastructure and by extensive integration of services [1].

The purpose of this work is to analyze the existing European approach to assessing transport infrastructure expenditures and costs, their impact on transport performance at the country level, as well as trends in Ukrainian policy regarding the support and development of road infrastructure.

Literature analysis. At the moment, there are many studies concerning the relationship between the level of road infrastructure and the country's economy.

Numerous authors of the work [2] present methods and models for assessing the impact of transport projects on economic development.

Research [3] provides a modern overview of transport infrastructure costs and expenses. This report is produced with in the project 'Sustainable Transport Infrastructure Charging and Internalisation of Transport Externalities'.

Here are some definitions of the term "infrastructure". Dmytriieva O.I. formed a vision of transport infrastructure as a complex of objects, within which transport, terminal, warehousing, commercial and virtual-information service of consumers of transport services is provided, and also scientific-production support and management of transport process is carried out [4].

In [3] transport infrastructure is understood as "a physical and organizational network that allows to move between different places".

CE Delft [5] presents cost data for 2013 for the entire road network for all EU 28 countries. In addition, in work [6] the costs of highway infrastructure for trucks and vans are estimated.

Studies like [7, 8], devoted to marginal road infrastructure costs.

According to the work [9], the transport infrastructure provides transportation of goods and passengers, including communications of various modes of transport - railways, highways, inland waterways, sea and air routes, pipelines for pumping oil and gas, transport and logistics enterprises working in the field of movement of people and goods.

In Guiding Principles for Practitioners and Policy Makers [1], in particular, the role of road transport in economic development is stated. In particular, it is argued that adequate infrastructure provides physical links between regions and countries, with road transport services playing a key role in unlocking economic potential.

Presentation of the main results. Road transport has an important social dimension through the opportunities it offers for entrepreneurship and job creation. The sector has traditionally played a key role in upward mobility as it allowed, for example, professional drivers to become entrepreneurs and create their own business, developing it as a small or medium size company. In general, road transport can create a significant number of jobs. A recent study in East Africa found that there were 1.2 jobs for each truck on the road. In addition to the direct employment, the sector generates a significant number of indirect jobs and employment. The indirect employment includes various transport related activities such as infrastructure building and maintenance in particular in areas dedicated to road transport services (fuel stations, secured parking, cold chain storage, warehouses and repair/maintenance activities), rescue and emergency services, forwarding and brokerage, vehicle manufacturers and specialized insurance businesses. ILO data suggest that employment in road transport can reach five percent of total employment [1].

The infrastructure sector is not only the cost of services provided to counterparties of all groups, but also a guarantee of efficiency, mobility and uninterrupted economic activity, the stability of relations with counterparties all over the world [10].

Thus, according to Eurostat, the transport sector brings about 5% to the EU economy, another 2% is added by transport engineering. Problems arising in the course of transportation, in turn, are estimated at 1% of GDP, car accidents with human casualties cause damage to the economies of developed countries in the amount of at least 2% of the gross product [10].

According to a McKinsey research report, to support sustainable economic growth in the world in line with forecasts for 2030, it is necessary to cover the need for additional investment of $ 3.3 trillion annually, equivalent to 3.8% of world GDP [11].

McKinsey also argues that $ 1 of additional infrastructure investment can increase GDP in the long term by 20 cents only through the indirect effect of increasing labor productivity, excluding effect from the construction itself.

Columbia University in the United States, in research of 95 countries [12], claims that doubling road density on average results in an increase in economic growth of 1% annually. An increase in the "aggregate infrastructure provision" of the economy by 10% leads to an increase in output in the economy by 1%. According to their own estimates, the coefficient of elasticity of output in the economy as a whole to the level of development of transport infrastructure is 7%.

World Bank claims [13], that an increase in assets in the infrastructure sectors of the economy by 2 times leads to an increase in GDP by an average of 15 pp, but this applies only to "developed" countries. And the elasticity of output to the level of infrastructure development ranges from 7% to 10%, which is surprisingly correlated with the data of Columbia University.

Fig. 1 gives an overview of the existing policy instruments in the transport sector and the related outputs and potential outcomes of using one or several of the instruments..

The European Union has conducted a global study of transport infrastructure costs in EU countries [15].

In particular, this study aims to provide overall, average and marginal infrastructure costs for road transport, rail transport, inland waterway transport (IWT), maritime transport and aviation in the EU28 member states and some other western countries (Norway, Switzerland, US states of California and Missouri, Canadian provinces of Alberta and British Columbia, and Japan) [15]. The study identifies the so-called marginal costs of various modes of transport in euros per kilometer traveled, ton-kilometer, passenger-kilometer, etc. Appropriate marginal costs can be found according to the rolling stock used. For example, for motor transport there is a

classification into passenger and freight transport, each of which further has its own categories: passenger - passenger car, bus, coach, motorcycle; freight - HGV (heavy freight transport - more than 3.5 tons) and LCV (light commercial freight transport - up to 3.5 tons).

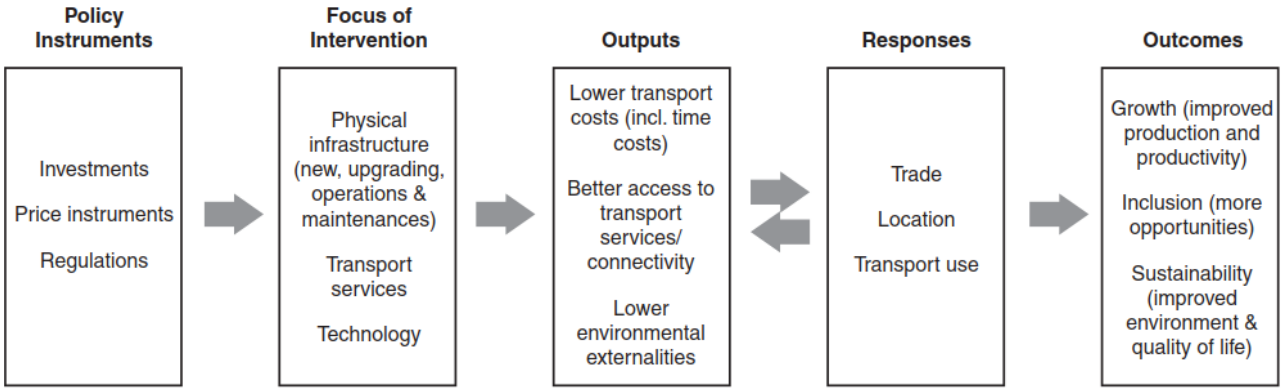

Figure 1 - Impacts of Transport Policies: The Mechanisms
Source: based on [14]

Transport infrastructure costs include the investment in new infrastructure, the cost of upgrading the existing infrastructure, the cost of maintaining the infrastructure, and the operating costs to enable the use of the transport infrastructure.

For road, rail and inland waterway transport, total infrastructure costs in the 28 EU countries were EUR 267 billion in 2016 (Fig. 2)..

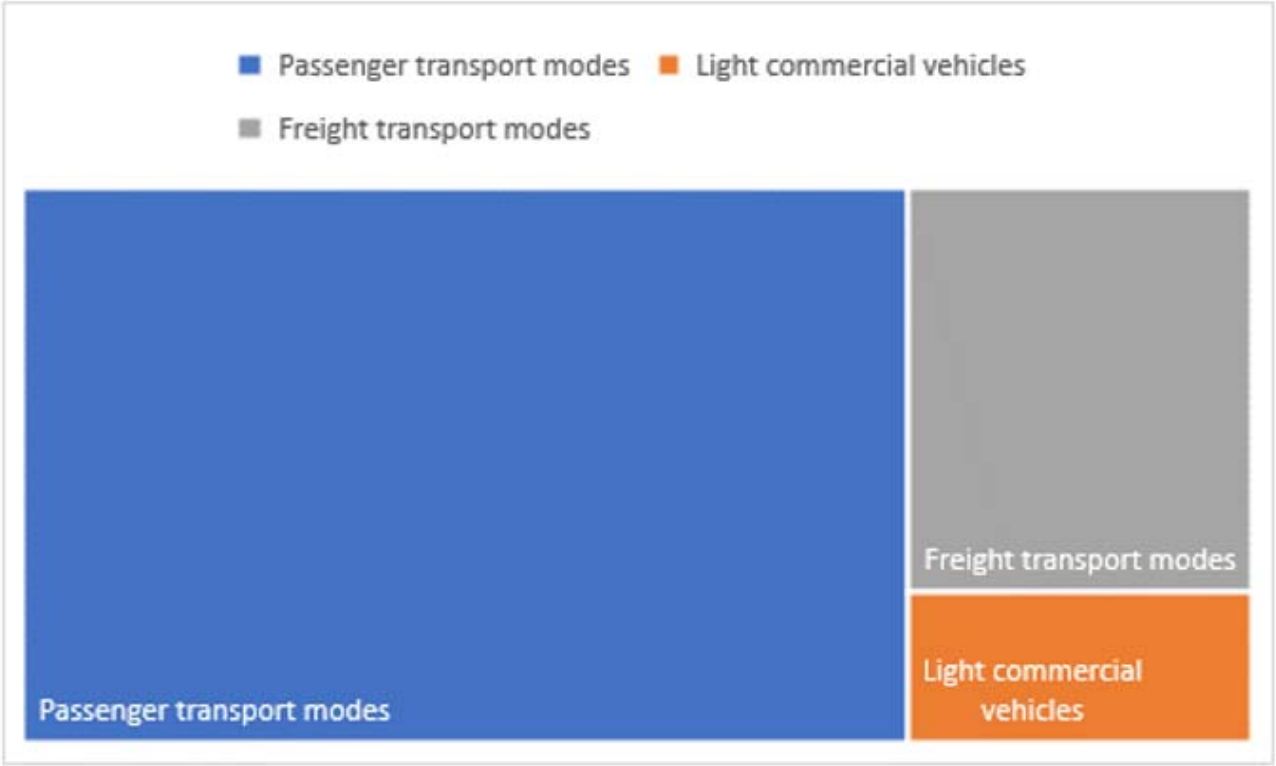

Figure 2 - Total infrastructure costs in EU, Billion € (2016)
Source: based on [15].

Marginal infrastructure costs refer to the additional costs to the transport infrastructure manager caused by an additional vehicle kilometer (or call or LTO) on the network. In this study, the variable part of the average infrastructure costs (usage-dependent renewal and maintenance costs) are used as a substitute for the marginal infrastructure costs.

In [15] it is noted that the construction, maintenance and management of transport infrastructure entails significant costs. In contrast to the benefits, the external and infrastructure costs of transport without political intervention are usually not borne by transport users and are therefore not taken into account in their transport decisions. By internalizing external and infrastructure costs (i.e. incorporating these costs into decision making), the efficiency of the transport system can be improved.

In practice, there are also large differences in approaches to the internalization of infrastructure (and external) costs. For example, Directive 2011/76 / EU [16] prescribes that road infrastructure charges for heavy vehicles in Europe should be based on a cost recovery principle, i.e. the weighted average infrastructure charges should be linked to construction costs, as well as the costs of operation, maintenance and development of the corresponding infrastructure network. On the other hand, Directive 2012/34 / EU [17] requires that EU rail use charges be based on direct network-wide costs, that is, costs that are directly related to use of rail infrastructure.

Productivity data for road transport are taken from Eurostat according to the principle of nationality, that is, transport activities are distributed according to the countries in which the vehicle is registered. In an alternative territorial approach, transport activities are allocated to the countries in which these activities are actually carried out. For example, kilometers driven by Polish cars in Germany are counted in Poland if the principle of nationality applies, and in Germany if the territorial principle applies. The territorial principle would be more consistent with the size of infrastructure costs. However, since a detailed EU-wide dataset on road transport efficiency based on the territorial principle is not available, the official Eurostat data set based on the citizenship principle was used for this study.

This study [15] presents both investment and O&M costs of transport infrastructure [18]. More specific:

- improvement costs are all costs of new infrastructure or expansion of existing infrastructure in terms of functionality and / or lifetime;

- upgrade costs are all costs associated with upgrading (parts of) the infrastructure. The updated infrastructure (parts) will have a service life of at least 1–2 years. Upgrade and upgrade costs can be incurred at any time and are not directly related to the condition of the assets.

Operating and maintenance costs include two elements:

- maintenance costs are costs associated with "normal" maintenance, ie maintenance that cannot be avoided. These actions do not change the performance of the infrastructure object, but simply keep it in good working order or restore it to its previous state in the event of a breakdown. These are all relatively minor repairs with an economic life of less than 1-2 years;

- operating expenses are those that are spent on the efficient use of infrastructure (e.g. lighting, traffic control).

The main direct users of road infrastructure, affecting related costs, are cars and motorcycles, buses and trucks. According to the authors, although pedestrians and bicycles are also road users, their impact on the cost of road infrastructure is negligible, which predetermined the exclusion of these categories of users from comparative estimates.

To analyze the real impact of investments in infrastructure (investment and support) on the state of the transport sector, statistics were taken for the EU countries, namely:

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- the number of ton-kilometers traveled per year;
- the volume of investments in road infrastructure per year;
- the amount of funds for the maintenance of road infrastructure per year.

The factor of the number of ton-kilometers traveled (transport work) was taken as one of the main indicators of transport performance, showing the volume of traffic and the level of development of logistics in the country. In addition, the number of ton-kilometers performed is one of the general economic indicators of the country's development, which, in turn, affects trade relations both within the country and abroad.

Considering that the effect of investments in infrastructure may not appear immediately, data on the above three indicators were taken for 2 years - 2016 and 2019 (Fig. 3, Fig. 4) [19].

a) b) c)

Figure 3 - Data on transport infrastructure (2016): a) Freight road transport, Million ton-kilometers; b) Road Infrastructure investment, Euro; c) Road Infrastructure maintenance, Euro

a) b) c)

Fig. 4. Data on transport infrastructure (2019): a) Freight road transport, Million ton-kilometers; b) Road Infrastructure investment, Euro; c) Road Infrastructure maintenance, Euro

It is known that the relationship between two parameters can be successfully estimated using the correlation coefficient:

$$r_{xy} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2}\sqrt{\sum_{i=1}^{n}(y_i - \bar{y})^2}}$$

where:

r_{xy} – the correlation coefficient of the linear relationship between the variables x and y;
x_i – the values of the x-variable in a sample;
$\bar{x}$ – the mean of the values of the x-variable;
y_i – the values of the y-variable in a sample;
$\bar{y}$ – the mean of the values of the y-variable.

To assess the closeness of the relationship between investments in road infrastructure and the performed ton-kilometers, the logic set out in Table 1 was adopted.

Table 1 - Assessment of the degree of relationship by the value of the correlation coefficient

Scale of correlation coefficient	Conclusion
$0< r \leq 0.19$	Very Low Correlation (no correlation)
$0.2 \leq r \leq 0.39$	Low Correlation
$0.4 \leq r \leq 0.59$	Moderate Correlation
$0.6 \leq r \leq 0.79$	High Correlation
$0.8 \leq r \leq 1.0$	Very High (almost linear) correlation

It should be noted that the indicators were taken only for those countries for which statistics were available for 2016 and 2019. Unfortunately, for some countries it was not possible to obtain values for 2019, so the level of correlation was estimated without them.

The relationship between investments in road infrastructure and the volume of transport work performed in tkm was analyzed (Table 2).

Table 2 - Volume of transport work and infrastructure investment (2016, 2019)

Country of the EU	Transport work, million ton-kilometers		Infrastructure investment, Euro	
	2016	2019	2016	2019
Austria	26138	26502	444000000	562000000
Bulgaria	35402	20613	163104612	528172615
Croatia	11337	12477	197358816	354803052
Czech Republic	50315	39059	849231714	1383064925
Estonia	6717	4795	148600000	220000000
Finland	26853	28847	1178000000	1522000000
France	151213	181400	9216000000	9816000000
Germany	315769	311869	12870000000	16650000000
Greece	24560	28197	2187037728	710327243
Hungary	40006	36951	802745136	2288587059
Ireland	11564	12403	622000000	837000000
Latvia	14227	14965	190000000	223000000
Lithuania	30974	53117	357000000	352000000
Poland	303560	395311	3075442295	2415357766
Slovenia	2135	2306	100000000	204000000
Spain	216993	249555	3880000000	3445000000
Sweden	42686	42601	2086339294	2503424108

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The obtained correlation coefficients between the performed ton-kilometers and the volume of investments in infrastructure are set out in Table. 3.

Table 3 - Coefficients of correlation between the performed transport work and the volume of investments in road infrastructure

(Year of investment) - (Year of transport work)	Correlation coefficient	Conclusion
2016-2016	0,78	High Correlation (but next to Very High Correlation)
2019-2019	0,65	High Correlation (but next to Moderate Correlation)
2016-2019	0,73	High Correlation

It can be concluded that the effect of investments in transport infrastructure is strongly manifested both in the same year and affects subsequent years in terms of the volume of annual transport work. That is, an increase in investment in road infrastructure clearly has a positive effect on the volume of transport work performed.

We analyzed the relationship between the costs of maintaining the road infrastructure and the volume of transport work performed in the tkm. Unfortunately, data on investments in road infrastructure maintenance for both years is contained in statistics for few of EU countries. Correlation analysis was carried out only for these countries (Table 4).

Table 4 - The volume of transport work and investment in Infrastructure Maintenance (2016, 2019)

Country	Infrastructure Maintenance, Euro		Transport work, Million ton-kilometers	
	2016	2019	2016	2019
France	2430850000	2324750000	151213	181400
Hungary	292602581	375727022	40006	36951
Ireland	83000000	75000000	11564	12403
Latvia	175000000	179000000	14227	14965
Lithuania	152000000	147000000	30974	53117
Poland	418690989	480977312	303560	395311
Slovenia	138000000	206000000	2135	2306
Sweden	1129994824	999839421	42686	42601

The obtained correlation coefficients between the executed ton-kilometers and the volume of investments for the maintenance of road infrastructure are presented in Table. 5..

Table 5 – Coefficients of correlation between the performed transport work and the volume of investments in infrastructure

(Year of investment) - (Year of transport work)	**Correlation coefficient**	**Conclusion**
2016-2016	0,35	Low Correlation
2019-2019	0,30	Low Correlation
2016-2019	0,33	Low Correlation

It can be concluded that the effect of investments in maintaining the transport infrastructure has little effect on the volume of transport work. That is, an increase in investments in the maintenance of road infrastructure does not have a pronounced positive effect on the volume of transport work performed.

As for Ukrainian research, according to [20], in 2016, transport, warehousing, postal and courier activities accounted for about 6.6 % of gross domestic product and 6.1 % of the total employed population. The most dependent on the transport industry are agriculture, metallurgical production, coal industry, mining, chemical and food industry, construction, retail trade, communications and postal services, defense.

At the time of approval of the National Transport Strategy of Ukraine for the period up to 2030 [20] the transport industry as a whole met only the basic needs of the population and the economy in transportation by volume, but not by quality. It was noted that the state of the transport sector does not fully meet the requirements of the effective implementation of Ukraine's European integration course and the integration of the national transport network into the Trans-European Transport Network.

Currently, the President of Ukraine has introduced an unprecedented program for the construction of road infrastructure - "Big Construction".

The Big Construction project is a large-scale development of high-quality infrastructure in Ukraine. Two years of implementation of the Big Construction program have significantly changed the road market in Ukraine. The construction and repair of the longest state roads and man-made structures in the history of Independence has been a powerful impetus for the growth of existing and the emergence of new companies. During the pandemic, public investment in a high-multiplier infrastructure sector mitigated the fall in GDP in 2020. According to experts of the Kyiv School of Economics, long-term effects as a result of the project "Big Construction" will increase GDP in the next 5 years by 2.2% [21].

One of the tasks of the project in 2021 is the construction or reconstruction of 6.6 thousand km of roads, based on the principles of energy efficiency and high quality, inclusiveness and focus on every Ukrainian as a customer [22].

Results of the transport infrastructure project for 2020:

- 258 bridges and overpasses on local and state roads were built, reconstructed and overhauled;

- 4056 km of state roads were built and repaired;

- 2527 km of local roads were built and repaired;

These values are twice the volume of the most productive 2018 (Fig. 5).

The plan for 2021 is 6500 km of roads: 4500 km of state roads and 2000 km of local ones.

Funds from the state budget, the State Fund for Regional Development and local budgets will be used to implement the project.

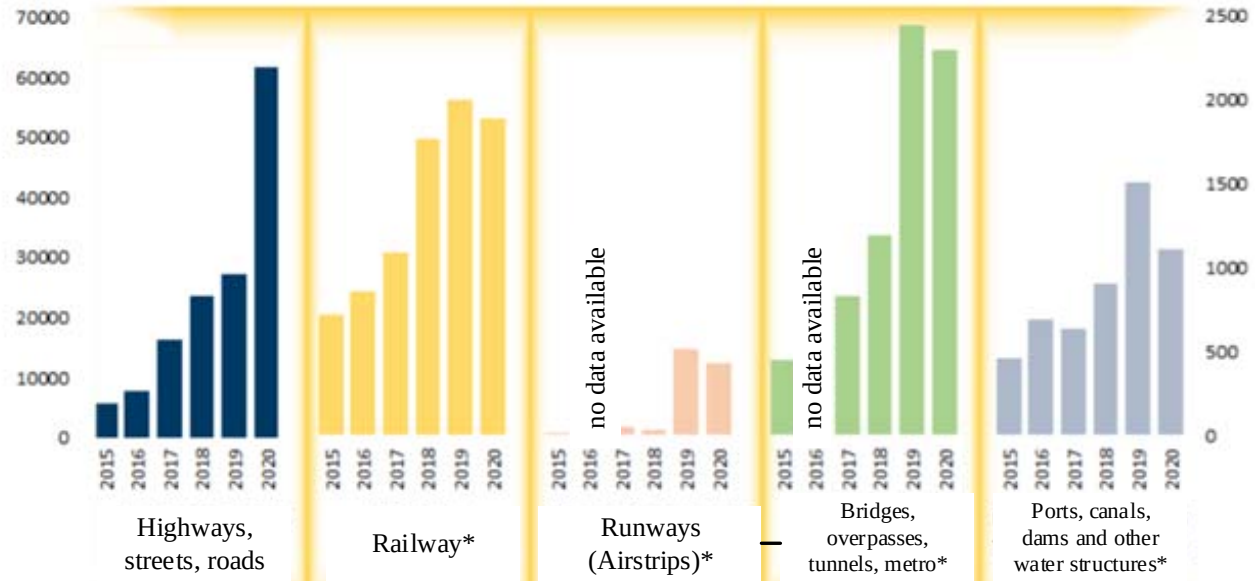

Figure 5 – Construction of infrastructure structures during 2015-2020, UAH billion [23]

Regarding the end time of the project, President Volodymyr Zelensky stated that the Big Construction program will end when "bad roads end" [24]. Moreover, the goal of Big Construction should be not only the maximum mileage of the renovated roads, but also the maximum durability of the repaired routes.

It is planned that in 2022 Ukravtodor will receive UAH 79 billion directly from the state budget for the repair and construction of new state roads, and another UAH 45 billion will be lent by banks and international financial organizations under state guarantees, so UAH 124 billion should be accumulated together. For comparison: in 2021 in the state budget for Big Construction was laid about 110 billion UAH, i.e. 10% less [25].

It is projected that in 2024, thanks to road works under the Big Construction, Ukraine's GDP will be 4.4% higher than GDP in 2020 [26].

Consider the global experience of investing in the country's road infrastructure and the relationship of such investments and national economic indicators.

It is known that foreign countries pay considerable attention to investment in roads and show significant socio-economic effects from new and improving the quality of existing roads.

The most similar to the Big Construction is the project of road development in Poland in 2007-2012 (the period of active reconstruction of infrastructure under the EU program "Infrastructure and Environment"). The direct immediate economic effect of road construction in 2007–2013 was reflected in the annual average contribution to GDP growth of 0.3%. We can draw parallels with the Latvian construction in Saulkrasti. The improvement in traffic safety was estimated at 23% of the total socio-economic effect of the project - 89 million euros per year. Additional effects were noise reduction and air pollution in the city. In Turkey, in 2003-2019, highway development projects were implemented. The three involved highway projects were to give a total GDP growth of 1.6%.

Belarus has an interesting experience, in particular, regarding the M5 motorway and the fare system. In 2006-2015, the state program Roads of Belarus continued in Belarus. Belarus has a positive experience in tolling and sees it as an important source of funding for infrastructure construction. This allows to partially solve the problem of

overweight trucks, because it depends on the weight of the fare [26].

Thus, the experience of developed countries shows a positive relationship between investments in the maintenance and construction of transport infrastructure and economic indicators of the state.

At the same time, there is reason to believe that investing significant funds in infrastructure projects for a certain type of transport may result in a decrease in work performed on other types. In particular, in the realities of Ukraine, there is a bias of financial injections towards road and air transport (Fig. 6).

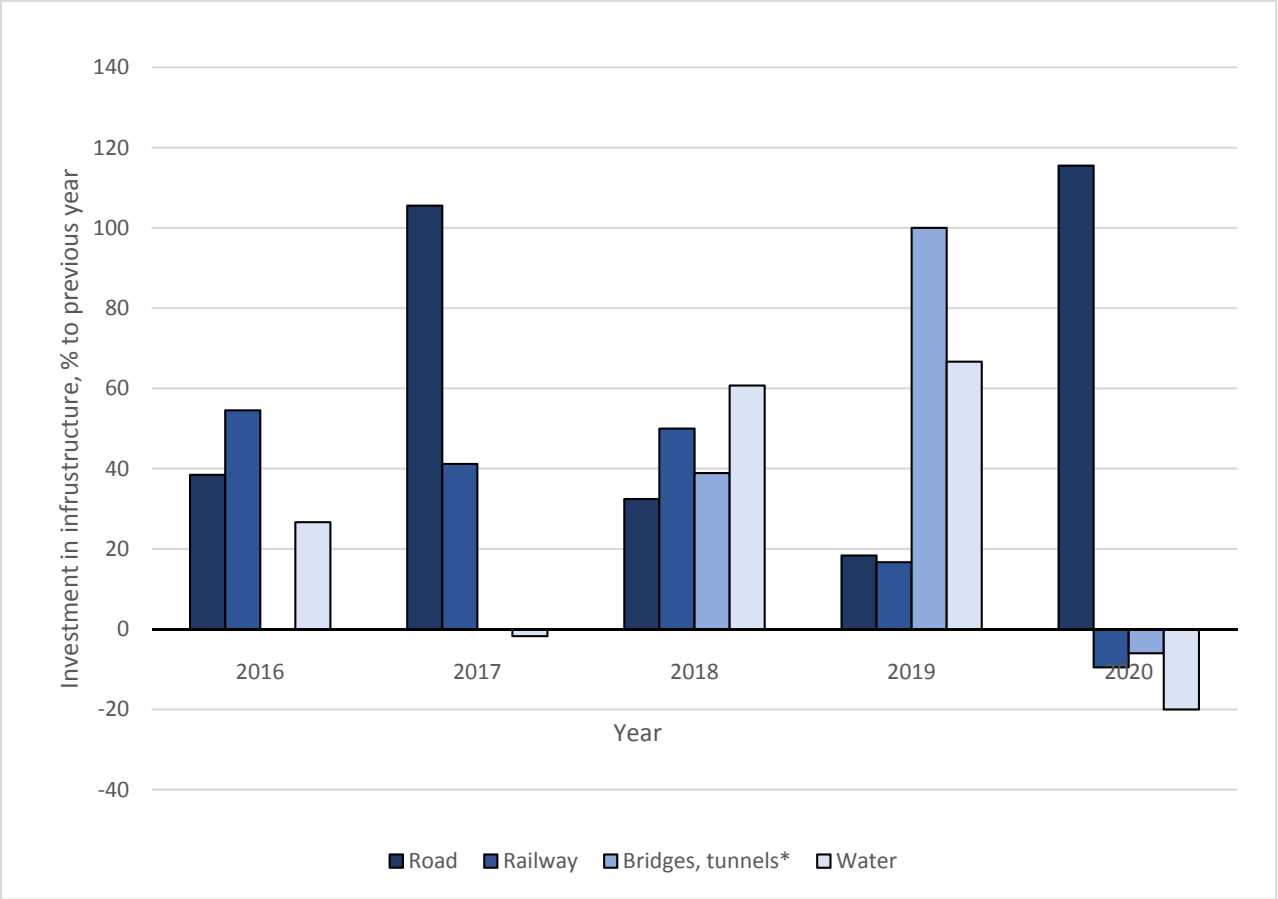

Figure 6 – Growth in investment in transport infrastructure in relation to the previous year for various modes of transport (* - no available data for 2016-2017)

Such a distribution of infrastructure funds should lead to an outflow of goods and passengers from, for example, rail transport. This consideration is confirmed by the metric ton-kilometers performed (Fig. 7).

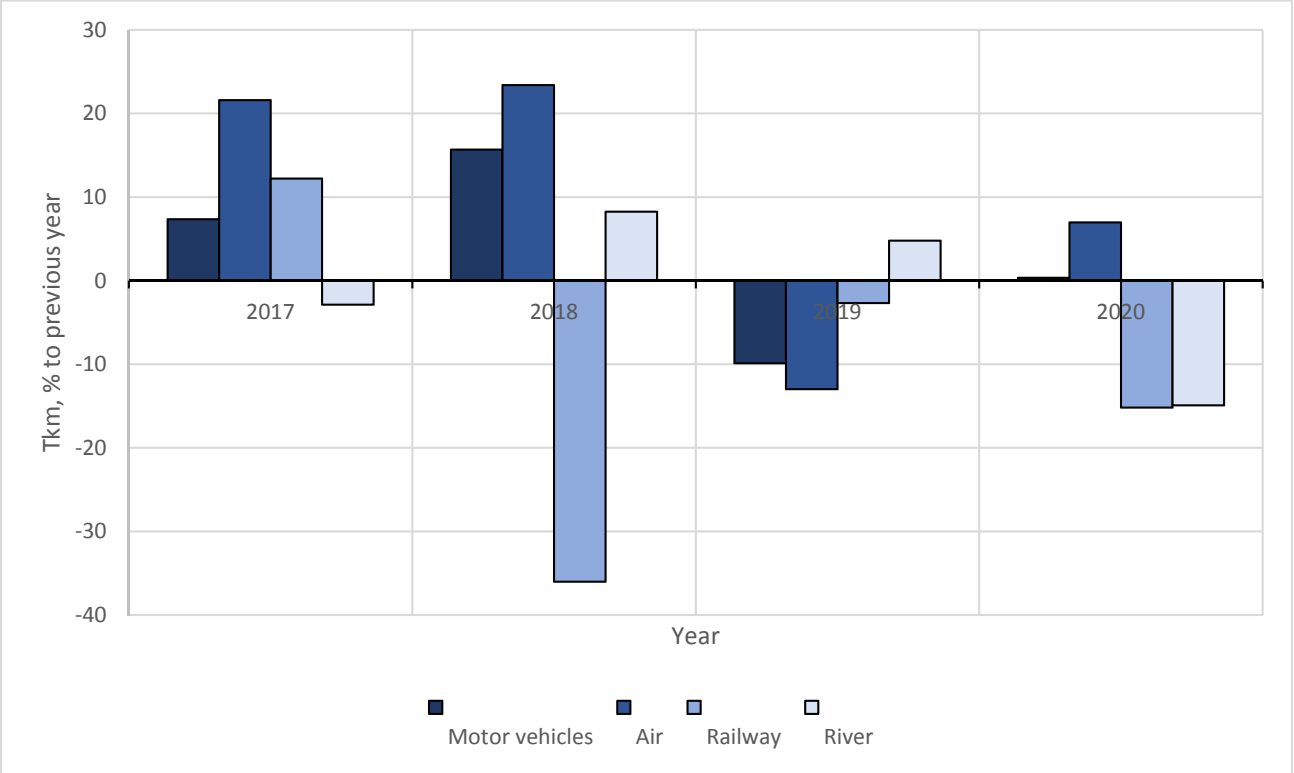

Figure 7 – Growth in ton-kilometers performed in relation to the previous year for various modes of transport (based on [23])

Fig. 8 shows performed estimation of the general state of the transport sector (in terms of ton-kilometers and investments) in% of the previous year.

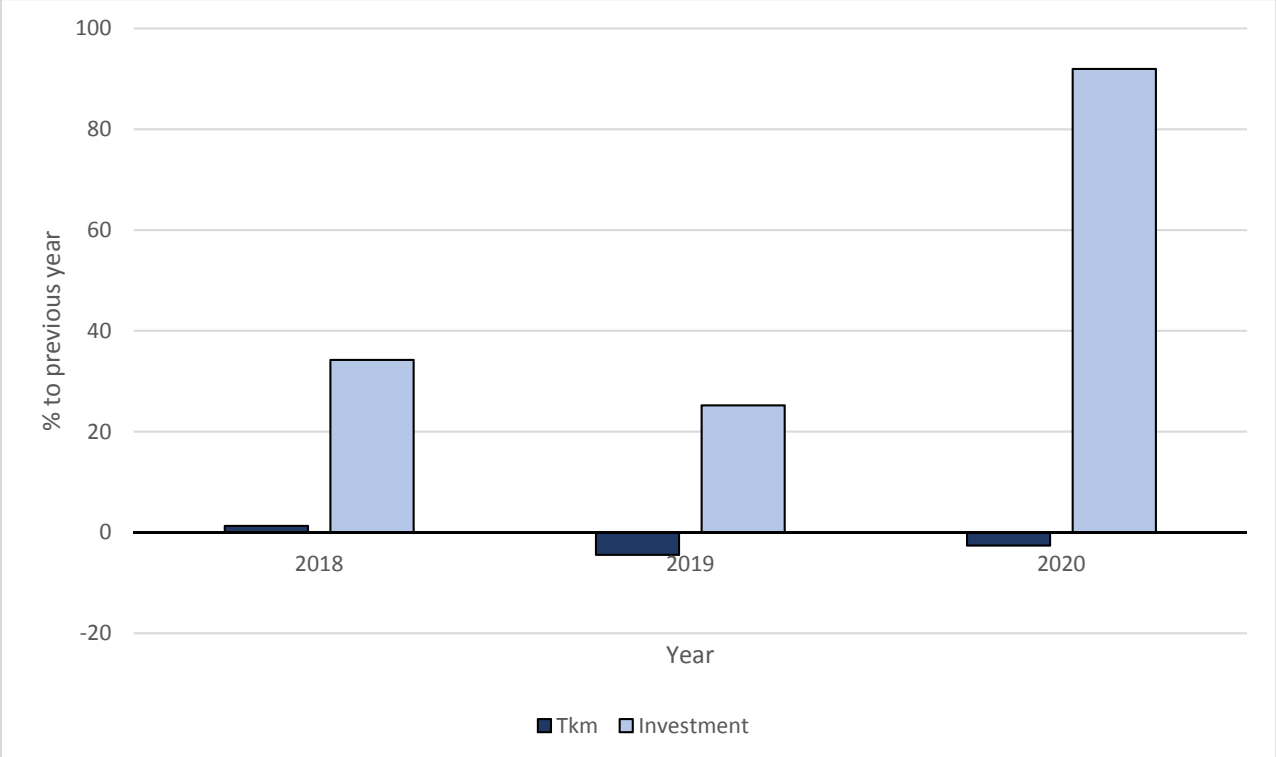

Figure 8 – Ton-kilometers and investments for all types of transport (in% of the previous year)

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It can be clearly seen that for Ukraine at the moment there is no positive dynamics of the influence of investments in transport infrastructure on the amount of transport work performed. The correlation coefficient of these two indicators is (-0.88), which is equivalent to a strong inverse correlation. That is, an increase in investments in transport infrastructure has the opposite effect on the indicator of transport work, reducing the number of ton-kilometers performed. The reasons for this state of affairs may be different (including their combination):

1. Perhaps, the positive effect of investments in transport infrastructure for Ukraine will not appear immediately, and an increase in the performed transport work will occur in a few years.

2. It is possible that the volume of investments in transport infrastructure does not directly affect the volume of transport work performed and a positive effect only in national indicators (for example, GDP) should be expected.

3. It is possible that investments in transport infrastructure will be noticeable only in the context of transit flows, which will increase the attractiveness of Ukraine for international transportation.

4. Perhaps, that there is no positive effect from significant investments due to the facts of corruption and theft of investment funds.

C**onclusions.** Thus, according to the study, a general conclusion can be drawn about the impact of investments in the EU transport infrastructure on the volume of transport work performed:

- an increase in investments in road infrastructure brings a positive effect on the transport industry of the European Union, namely, on the amount of transport work performed (in tkm);

- the volume of investments in the EU infrastructure brings a much greater positive effect than funds for road maintenance;

- based on the available statistics, it is not possible to determine whether there is a difference in the short- or long-term impact of investments in EU road infrastructure on the volume of transport work. This relationship requires further study.

In addition, good transport infrastructure is a necessary, but not a sufficient condition for growth. For example, the experience of recent years in Ukraine does not show any positive effect from a large-scale infrastructure project Big Construction on the volume of internal transport work performed. The huge funds allocated for the project have not yet increased the volume of ton-kilometers. The reasons may lie both in the impossibility of obtaining a quick effect from improving the infrastructure, and in the facts of corruption and theft of funds allocated for the project. The higher level of infrastructure services could be used to increase the volume of transit flows, combining investments with the launch of toll road experience for the most attractive directions in terms of transit flows.

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DIGITALIZATION OF LOGISTICS COMPANY BUSINESS PROCESS IN CONDITIONS OF INDUSTRY 4.0

Sergiy Gritsenko, Olga Karpun, Anastasia Kolisnichenko. «Digitalization of logistics company business process in conditions of industry 4.0». *The article defines that the digitalization of logistics business processes is, if not obligatory, then a very necessary process that allows company reach a new level. Keeping customers in growing competition, providing quality services, reducing the cost of logistics allows company to do the job correctly and efficiently. So the introduction of modern technologies in the logistics company is an integral step towards scaling up and growth.*

The essence of the company activity digitalization is not to digitize any channel, individual production operation or a separate business process, but in a complex approach to the transformation of the company, covering all areas of the company and all areas of economic activity.

The need for the logistics industry to adapt to this new digital age in order to evolve has been proven. Enterprise business process digitalization tools are more flexible tools due to their user interface customization capabilities and integration capabilities with most advanced systems. New purpose – automation of business processes with the use of smart technologies allows company to simplify the load when performing their daily tasks to each employee.

The aim of the article is to develop proposals and recommendations for improving the management of the company's logistics business processes by their digitalization.

It is claimed that due to the modern policy of increasing digitalization in the company AsstrA Ukraine, there is an increase in indicators and quality of work performance, increasing the level of job satisfaction among employees, which is the key to further growth of the company.

It is noted that digital technologies allow to automate supply chain management processes, which reduces operating costs, facilitates simpler and faster billing methods, improves customer service and develops an important new era for building ideal and competitive supply chains.

***Keywords**:* digitalization of business processes, logistics companies, management, digital transformation, AsstrA Ukraine.

Сергій Гриценко, Ольга Карпунь, Анастасія Колісніченко. "Діджиталізація бізнес-процесів логістичної компанії в умовах промисловості 4.0". *У статті визначено, що діджиталізація сфери логістичних бізнес-процесів є, якщо не обов'язковим, то дуже необхідним процесом, що дозволяє вийти на новий рівень. Утримання клієнтів на тлі зростаючої конкуренції, надання якісних послуг, зниження витрат на організацію логістики дозволяють виконувати роботу правильно та ефективно. Так що впровадження сучасних технологій в логістичну компанію – невід'ємний крок до масштабування і зростання.*

Суть цифровізації діяльності компанії не в тому щоб оцифрувати будь-який канал або окрему виробничу операцію, окремий бізнес-процес, але в комплексному підході до трансформації діяльності компанії, що охоплює всі сфери діяльності компанії та всі сфери господарської діяльності.

Доведено необхідність для галузі логістики, яка повинна адаптуватися до цієї нової цифрової епохи, щоб розвиватися. Інструменти діджиталізації бізнес-процесів на підприємстві – це більш гнучкі інструменти завдяки їх можливостям налаштування інтерфейсу користувача і можливостям інтеграції з більшістю передових систем. Нове призначення – автоматизація бізнес-процесів з використанням смарт-технологій дозволяє спростити навантаження при виконанні своїх повсякденних завдань кожному працівникові.

Метою статті є розробка пропозицій та рекомендацій щодо вдосконалення управління логістичними бізнес-процесами компанії шляхом їх діджиталізації.

Стверджується, що завдяки сучасній політиці підвищення діджиталізації в компанії AsstrA Ukraine, спостерігається підвищення показників діяльності та покращення якості виконання роботи, зростає рівень задоволеності роботою серед працівників, що є запорукою подальшого росту компанії.

Зазначено, що цифрові технології дозволяють максимально автоматизувати процеси управління ланцюгами постачань, це призводить до зниження експлуатаційних витрат, сприяє більш простій і швидкій методиці узгодження рахунків, підвищенню якості обслуговування покупців і розвитку важливо нової епохи для зведення ідеальних і конкурентних ланцюгів постачань.

Ключові слова: діджиталізація бізнес-процесів, логістичні компанії, управління, цифрова трансформація, компанія AsstrA Ukraine.

Сергей Гриценко, Ольга Карпунь, Анастасия Колисниченко. «***Диджитализация бизнес-процессов логистической компании в условиях промышленности 4.0".*** *В статье определено, что диджитализация сферы логистических бизнес-процессов является если не обязательным, то очень необходимым процессом, позволяющим выйти на новый уровень. Удержание клиентов на фоне растущей конкуренции, предоставление качественных услуг, снижение затрат на организацию логистики позволяют выполнять работу правильно и эффективно. Так что внедрение современных технологий в логистическую компанию – неотъемлемый шаг к масштабированию и росту.*

Суть цифровизации деятельности компании не состоит в том, чтобы оцифровать любой канал или отдельную производственную операцию, отдельный бизнес-процесс, но в комплексном

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подходе к трансформации деятельности компании, охватывающей все сферы деятельности компании и все сферы хозяйственной деятельности.

Доказана необходимость в области логистики, которая должна адаптироваться к этой новой цифровой эпохе, чтобы развиваться. Инструменты диджитализации бизнес-процессов на предприятии – это более гибкие инструменты благодаря их возможностям настройки пользовательского интерфейса и возможностям интеграции с большинством передовых систем. Новое предназначение – автоматизация бизнес-процессов с использованием смарт-технологий позволяет упростить нагрузку при выполнении своих повседневных задач каждому работнику.

Целью статьи является разработка предложений и рекомендаций по совершенствованию управления бизнес-процессами компании путем их диджитализации.

Утверждается, что благодаря современной политике повышения диджитализации в компании AsstrA Ukraine, наблюдается повышение показателей деятельности и улучшение качества выполнения работы, растет уровень удовлетворенности работой среди работников, что является залогом дальнейшего роста компании.

Отмечено, что цифровые технологии позволяют максимально автоматизировать процессы управления цепями поставок, это приводит к снижению эксплуатационных расходов, способствует более простой и быстрой методике согласования счетов, повышению качества обслуживания покупателей и развитию важной новой эпохи для создания идеальных и конкурентных цепей поставок..

Ключевые слова: диджитализация бизнес-процессов, логистические компании, управление, цифровая трансформация, компания AsstrA Ukraine.

Introduction. Digitalization in global is a concept of economic activity based on digital technologies implemented in various spheres of life and production. Innovation is important for every industry. Innovation is the main path that ensures the constant growth and prosperity of the company [1, p. 9]. To stay competitive, companies need to innovate and optimize their processes.

Currently, an important competitive advantage for a logistics company is the ability to flexibly manage the supply chain, i.e. the company's ability to respond quickly and at the lowest cost to changes in the external environment and regulatory violations.

Digitalization of business processes in the field of logistics at the present stage of rethinking business is more important than ever, because due to inefficient construction of internal logistics processes in the world, automation of business networks has become an acute problem on the background of globalization. Automation processes can reduce time at all stages of the supply chain, thus simplifying routine actions and making them more efficient, minimizing the probability of error.

Business – process – can be defined as a set of activities (organizations), through which specific initial components are transformed into original components in accordance with pre-established specifications, in order to create value for the consumer [1, p. 300]. The use of digitalization facilitates the implementation of logistics business processes.

Innovation of a process / business model differs in that the resulting competitive advantage lasts longer than from a product or service innovation. Competitors often quickly copy related product or service innovations, but very slowly replicate process innovations [2, p. 78]. In this regard, radical digital innovations of logistics business processes have a much greater competitive potential of Industry 4.0 [3, p. 129].

Analysis of recent research and publications. In the economic literature, much attention is paid to the digital transformation of structural changes in the

economy of the regions, in marketing, logistics and commerce [3-10].

Studies have also shown that increasing digital transformation has led to increased cooperation in supply chains.

However, the highlighted approaches to the improvement of logistics activities through digitalization do not contain the features of the management of logistics business processes for their application in today's environment, which requires further research.

The purpose and objectives of the research: development of proposals and recommendations for improving the management of the company's logistics business processes by their digitalization.

The main material and results of the research. The last decade has seen the steady growth and spread of digital applications and platforms in logistics, in part due to the conscious push of companies to implement technologies that increase efficiency and reduce costs.

The impact of digitalization and automation on the supply chain is widespread. Digitization provides greater transparency in supply chains and scheduling, and thus improves supply chain management.

Digitalization has changed the way people communicate and interact with others. New technologies and gadgets, including smartphones, computers, drones and smart portable devices, have changed the way we access and disseminate information. These innovations and digital transformations apply to every industry, and supply chains are no exception. Digitization in supply chains encompasses digital products and services, as well as supply chain management in companies that are undergoing such rapid change. To benefit from the digital supply chain, new approaches need to be used, including digital transformation through technologies.

The dissemination of technologies and capabilities in digital supply chains means that companies need to be serious about outsourcing these functions. This, in turn, will contribute to the emergence of fundamentally new business models and the discussion of supply chain management as proposals. Digital transformation is better than anything else, allows companies to effectively use multiple channels of communication with customers, integrating them into a single system (omnichannel), opens access to intelligent technologies for analyzing consumer preferences, helps to personalize communication with each customer. Customers see a modern company that takes their needs into account, so they are willing to make deals and return to the company again and again.

In this study, the digital supply chain is defined as a set of interrelated activities, processed through new technologies, involved in supply chain processes between suppliers and customers. In other words, the digital supply chain is a smart, new value-added process that uses new approaches, including digital transformation through technology, to create competitive value and network effects. Digital transformations allow companies to take advantage of additional features, such as barcode scanning, location-based services, and short-range communications.

The digitalization of the logistics company leads to a rethinking of business, structural changes in building future capacity in the areas of digital transformation [11]:

– Automation of interaction processes within the company. The company used to work on this principle. Accepts orders, sends them to contractors. They offer their conditions. The manager collects data manually, sends to the client. The client chooses, the order is formed, documents are prepared. Then reporting forms – all processes are controlled manually.

– Automating these processes significantly shortens the chain of action and saves time.

– Minimize errors. The human factor cannot be ruled out when processing

documents or drawing up a route. Digital tools allow minimizing errors.

– Cost reduction. Transport downtime is reduced, cargo handling is simplified, and the order fulfillment stage is easy to control. This saves a lot of money, and company owners can control the actions of employees, monitor compliance with fuel consumption.

– Reducing the workload on the manager. Reduces the number of additional questions, the customer can track the movement of their goods online through the application; choose their own time and delivery.

– Automation of document management. The speed of paperwork is significantly increased due to the introduction of new technologies in the logistics company. Some documents can be template; fast transfer of documentation simplifies work with clients.

– Increasing loyalty and company image. Clients receive timely information, simplifies the process of interaction with the company, there is an opportunity to evaluate the work, leave feedback and get information.

Most developed companies are already successfully applying the latest trends of business process management. At the same time, methods of their automation became widespread. However, a universal tool for this is the concept of continuous improvement of business processes – BPI – business process improvement. The concept implies a smooth change of business processes.

The main advantage of business process reengineering is that companies need to start a business from scratch, destroying old, unprofitable business processes.

As a result of redesigning the existing business processes of the enterprise redistributes and minimizes the use of various resources, improves the quality of customer service, simplifies the organizational structure of the enterprise, increases the efficiency of activities.

Enterprise business process automation tools are the most flexible tools due to their user interface customization capabilities and integration with most modern systems. The newest direction – automation of business processes with the use of smart technologies allows to lighten the load during the performance of their daily tasks to each employee. Examples are robotic bots, supplemented by artificial intelligence capabilities that help them learn from previous examples and take advantage of data processing or image recognition capabilities. These supplemented bots are sometimes called cognitive, or smart, bots that help work with large amounts of data from enterprise sensors; fill in web forms in accordance with the established restrictions; create reports on the information panel using an array of data from different information systems; to carry out a series of calculations with the subsequent redirection to other division; recognize form templates and automatically update software systems; monitor security systems to block the threat object; manage the consumption of inventory during the tracking of purchases and invoicing; carry out rapid credit checks and alert departments in the event of threatening transactions and fraud; perform batch processing of large amounts of data and other transactions; implement paperless paperwork and other related operations.

The second promising area is low-code application platforms that allow non-technical users to quickly automate modern applications. Initially, they were built for the rapid development of graphical user interface applications. Today, such platforms are flexible tools that can be used in any industry or business to quickly develop applications and automate tasks.

Special automation tools for business, such as automation of information business processes, are a promising tool that can automate complex multisystem processes. This tool helps departments reduce service time by automating common tasks. In particular, it is the provision of a virtual server, which usually requires a number of steps to enter data manually. The automation module can monitor approved reserve requests; start

the process of turning on the server after receiving an approved request to change the reserve; configure server settings, initiate server shutdown.

Choosing a specific tool to improve the management of business processes in the enterprise requires careful analysis and justification of future business development strategy, because the automation of only one business process may be ineffective. The process of automation of business processes in the enterprise must be complex.

The most promising tool in this direction is the use of information and computer technology, and a possible approach to the description of business processes and evaluation of their effectiveness is the introduction of a system of production performance indicators. At the same time, most Ukrainian enterprises still do not use the same systematic approaches to calculating the system of efficiency in the implementation of each business process. And this is a requirement of many international standards, compliance with which is obligatory when entering foreign markets and integration into global value chains for domestic producers. Thus, the prospect of further research in the field of improving approaches to business process management is to substantiate the possibility of implementing a system for evaluating the effectiveness of business processes using information and computer technology.

Digital transformation is the introduction of modern technologies into the business processes of the enterprise. This approach involves not only the installation of modern hardware or software, but also fundamental changes in approaches to management, corporate culture and external communications. As a result, the productivity of each employee and the level of customer satisfaction increase, and the company gains a reputation as a progressive and modern organization.

Thus, AsstrA Ukraine is an international transport and logistics company, a global 3PL provider offering comprehensive services, including the organization of international transport by various modes of transport, import and export support, customs services, warehousing services, cargo insurance, project logistics, and trade services. The AsstrA group of companies is represented in Europe, Ukraine, CIS countries, Asia and the USA [12, 13].

The biggest advantage for the company is the provision of services by various modes of transport. It is also important that customers can deliver trucks of different sizes, as this can make delivery cheaper.

For the company, new firms in the same environment are direct competitors, as they will lower prices for customers to get them in their customer base, as well as give suppliers prices higher than market, just to attract them to their ranks. Of course, this will take time, and in order for AsstrA not to lose its position, they will also have to make discounts to customers and not lose their opportunities, at this point a very important reputation, which has developed over the years.

The main barriers for new companies in today's logistics market are competition, as it will be difficult for a new company to gain customers (gain them by lowering prices), and companies must be prepared for the fact that their activities will be unprofitable for a long time.

Currently, the number of competitors (Zammler, Raben, Pan-Logistics, etc.) is several thousand logistics companies operating in different countries and with different services.

Over the last 2 years, there have been significantly more imports and exports from Ukraine, so the logistics market is now more developed, and accordingly, many see the potential in this area.

It is also necessary to expand the list of competitive advantages, now the main ones for the company are: settlement with suppliers not in cash, but in the form of cheap fuel, acceleration of settlements, provision of customs broker services, own warehouses, etc.

The suppliers are companies that provide AsstrA freight facilities, and some of them provide freight customs services and temporary storage.

Suppliers can have both positive and negative effects on a company's profitability.

This is influenced by factors such as: the presence of competition between carriers, the season, the political and economic situation, the volume of supply and demand in the market.

Suppliers can also work with competing companies, so the company's competitors will know information about the company's customers and manipulate amounts in the market.

Suppliers are divided into several categories: A, B and C.

The first category includes regular carriers (an average of 5-10 cars per week), several hundred of which make up 15% of all in the company. The value of such carriers is that they are flexible – if companies need to make concessions on the price – they go, if the loading plans have changed – they quickly adapt to new ones, always in touch with the forwarder.

The second category is about 25-30% of all carriers of the company. The number of cars per week is about 5. The provision of services is the same as in category A.

Group C includes carriers who rarely use the company's services. The last group includes carriers with whom the company has not carried out transportation for a long time and so on.

The company provides various types of services – air, rail, road and sea transportation. Also transportation of excisable products, bulk cargo of various levels of danger, transportation of oversized cargo and prefabricated. Transportation is carried out to countries in Europe, Asia and sea transportation to / from the United States.

Each of the services provided by the company can be customized according to the customer's wishes, as it is a customer-oriented company.

Digital transformation of processes optimizes the work of employees of the enterprise, which increases the productivity of each individual team member. For example, automation of routine operations provides more time to solve really important and complex tasks. The company's SWOT matrix is presented in Table 1.

There is fierce competition in the logistics services market, and a customer-oriented development strategy helps to win the competition. Process automation helps to fully implement this strategy.

Thanks to the automation of business processes in AsstrA, work is established not only within the company, but also with partners – customers and suppliers of the company.

The supply chain has become more streamlined and optimized, all processes are reduced to clarity and transparency.

The result of the introduction of technology in the company was an increase in orders, increase the customer base, increase the efficiency of transportation participants. Eventually, the company's profit also increased as a result of increased workload over the same period.

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Table 1 –SWOT-matrix of the company AsstrA

	Strengths: High level of customer satisfaction; Reliable suppliers; Activity automation; Highly skilled workforce; Portfolio of strong brands; Strong free cash flow; Good return on capital.	Weakness: Product marketing must be better; It is not very successful to combine companies with different work cultures; Financial planning is not done properly and efficiently; There are gaps in the range of products sold by the company; Not very good forecast of demand for products.
Opportunities: New technology; Reducing the cost of transportation in the high season for customers (more profitability); Market development; Increasing the economy and increasing customer costs; State green drive; The main competencies of the organization; New trends in consumer behavior.	Strategy for the development of own software technologies; Market development; Increasing the economy and increasing customer costs; Activity automation; Highly skilled workforce; Portfolio of strong brands; Reliable suppliers.	Create a program for calculating financial planning; Develop SMM-advertising and advertising mailings to customers; Introduce information about new services / banner in company representatives; Expanding service capabilities will expand the customer base.
Threats: Lack of regular supply of innovative products; Increasing the level of wages; Liability laws vary from country to country; Changing consumer buying behavior; Demand for highly profitable products is seasonal; Expanding the presence market, finding new customers and paving new delivery routes; Fierce competition.	Company expansion; Access to new markets; Emergence of new services; Changing consumer buying behavior.	The company does not provide a full range of logistics services; Imperfect safety system in transport; Due to the long chain within the company, it is impossible to make quick decisions

The following is a table with a brief description of the functionality of the AsstrA programs used (Table 2)..

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Table 2 – Comparative analysis of AsstrA software systems

Name of systems	System description	Result
Electronic data exchange	Software for exchanging documents in and out of the company.	Thanks to the implementation of this program, the company saves a huge amount of paper, saves time on signing documents, as well as sending them to the appropriate person.
Shippeo	A company that transmit the actual locations of trucks.	Cooperation with this company allows to be more independent of carriers, quickly and accurately obtain the necessary information without the cooperation of third parties.
Supplier's office	The site where the actual loadings are posted, updates all the necessary information about the curator of transport, the location of the vehicle, is in contact with the supplier.	Working with this software allows to secure the company in working with suppliers, reduce all unnecessary costs. Document sharing will be available soon.
Client's office	The site, which publishes current loadings, updates all the necessary information about the curator of traffic, updates the location of the car and communicates with the client.	Working with this software allows to secure the company in working with suppliers, reduce all unnecessary costs. Document sharing will be available soon
GetRate	Program for calculating current tariffs.	Allows to reduce time of conversation with suppliers, to learn the present course.
Customer relationship management	Software for organizations designed to automate customer interaction strategies.	Increase sales, optimize marketing and improve customer service by storing customer information and relationship history, establishing and improving business processes and further analyzing results.
Corporate content management	Software that allows to manage digital documents and other types of content, as well as store, process and move within the organization.	This allows to optimize work within the company, reduce the time required to complete business processes for more actions.
Oracle Transport Management	Software for logistics companies allows to manage all aspects of transportation in the global supply chain.	The product helps reduce transportation costs, optimize service levels and automate processes so that the company can perform logistics operations more efficiently.

Using the above systems, the company can experience the following changes:

– reduction of time of repetitive processes;

– compliance with the process of supplier control;

– work of the company's employees independent of suppliers;

– speeding up the process of providing the necessary information to the client;

– blocking customers with receivables;

– tracking of the vehicle from the beginning of arrival at the place of loading to unloading of the vehicle;

– confidentiality of communication with suppliers and customers;

– increase the security of company data.

This suggests that due to the increase in the customer base, the demand for suppliers in the company has also increased. Therefore, the work through digitalization has gained momentum. As the company's own exchange was established, work time was accelerated and processes became more automated.

AsstrA Ukraine has already implemented a number of automated processes that already help employees save time on routine activities and thus provide more time to maintain customer relationships. At the moment, the company has implemented automatic verification of insurance policies of suppliers, a single database of documents, integration of freight telematics with the internal system, automatic distribution upon receipt of originals of transport documents and notification of accounts readiness for customs / customer.

Also, the introduction of new systems in the company improves its reputation among companies, thereby advertising among potential customers.

The use of new technologies accelerates processes by optimizing resources: human, financial, etc.

Work in the company has become more automated. Due to the constant information of the system, the employee is always aware of any changes and inconsistencies, which significantly reduces the response time.

Digital modification of actions improves the work of company employees, thereby increasing the productivity of each individual team member.

Thanks to the current policy of improving traffic safety, AsstrA will gain more and more regular customers, as well as more reliable carriers due to their thorough inspection through coordinated work within the company.

In recent years, digitalization has become one of the main tasks of the transport and logistics sector. The crisis triggered by the pandemic has shown that the development of technology directly affects the ability of businesses to adapt to new realities and survive difficult times without significant losses. The purpose of business digitalization is to measure the company's processes, collect data on indicators and sensors, as well as facilitate human work in routine, simple tasks. As a result, processes are better controlled. The availability of information allows to assess the situation and develop an optimal action plan.

Companies, including AsstrA-Associated Traffic AG, are restructuring their project activities using Agile's flexible development methodology. In a changing reality, "once and for all" planning no longer works. A roadmap with short sprints that take into account current circumstances with a constant focus on strategic objectives and goals gives better results. One and a half years of "new reality" have confirmed that it is not the strongest who survives, but those who are ready to react quickly and adapt to a changing environment. Digitalization is a faithful helper of business in these processes [16].

Conclusions. Restructuring the company's digital transition management by improving its software, including the digitalization of business processes, means that, despite significant investments, service delivery will be better, faster and better. It will also be a great competitive advantage in the current market, which will allow to work with many large progressive industries. Today, digital technologies are carrying out the fourth industrial revolution, which allows the convergence of digital and physical goods [3, p. 129].

The main purpose of automation is to improve the quality of the process. The automated process has more stable characteristics than the manual process. In many cases, process automation can increase productivity, reduce process execution time, reduce cost, and increase the accuracy and stability of operations.

In addition to the above, the digitalization of business processes is designed not only to provide consumers with the necessary information about the service, the location of the truck, the exchange of documents, but also to ensure the trust of

customers to the provider of these services. After all, thanks to information technology reduces the time to provide customers with the necessary information.

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ORGANIZATIONAL AND ECONOMIC MECHANISM OF STRATEGIC MANAGEMENT OF SUSTAINABILITY OF SUPPLY CHAINS OF INDUSTRIAL ENTERPRISES

Mariia Hryhorak, Nataliia Trushkina, Kateryna Kitrish. «Organizational and economic mechanism of strategic management of sustainability of supply chains of industrial enterprise0s». *The article deepens the theoretical and methodological foundations of the organization of strategic management of industrial enterprises` supply chains sustainability. The evolution of the concept of supply chain management is considered from the standpoint of the institutional theory, as well as the influencing of various factors on its development and integration with the concept of sustainable development is determined. The conceptual and categorical apparatus for researching supply chain sustainability management from the standpoint of network theory and stakeholder theory has been developed.*

On the example of a metallurgical enterprise, a system of indicators of sustainable development is proposed and strategic guidelines for three scenarios of sustainable development of an enterprise are determined. These three scenarios take into account the conditions for future development, which are defined as pessimistic, optimistic and such as to ensure balanced sustainable development. Calculations of strategic scenarios for sustainable development were based on the determination of threshold values of indicators for three components: economic (including the quality of corporate governance), environmental and social. Strategic benchmarks have been developed for each of the scenarios.

In the course of the study, it was found that it is inappropriate to calculate the integral sustainability index for the entire supply chain as a whole. Such a calculation has no informative value and is technically practically impossible due to the incomparability of indicators of different business units included in the supply chain. A conclusion is drawn from this that the sustainability of each individual business unit in the chain should be assessed separately.

An organizational and economic mechanism for managing the sustainability of the supply chain in a hybrid form is proposed, which provides for a combination of decentralized development of sustainable development strategies by individual enterprises and organizations within the supply chain and centralized coordination and monitoring of the implementation of strategies by a focal company based on a digital platform. The concept of this mechanism is based on a network approach and provides for the organization of collaboration of participants in the supply chain with the involvement of a wide range of stakeholders.

The directions in which various digital technologies can be applied in managing the sustainability of the supply chain are considered, among which blockchain technology is recognized as the most suitable for use at the moment.

***Keywords**:* supply chain, networks, management, sustainable development, indicators, strategic benchmarks, organizational and economic mechanism, stakeholders, digital platform, digital technologies.

Марія Григорак, Наталія Трушкіна, Катерина Кітріш. "Організаційно-економічний механізм стратегічного управління сталістю ланцюгів постачань промислових підприємств". *У статті поглиблено теоретико-методологічні основи організації стратегічного управління сталістю ланцюгів постачань промислових підприємств. Розглянуто еволюцію концепцій управління ланцюгом постачання з позицій інституційної теорії, а також визначено вплив різних факторів на їх розвиток та інтеграцію з концепцією сталого розвитку. Розроблено концептуально-категоріальний апарат дослідження управління сталістю ланцюгів постачань з позицій теорії мереж та теорії зацікавлених сторін.*

На прикладі металургійного підприємства запропоновано систему показників сталого розвитку та визначено стратегічні орієнтири для трьох сценаріїв сталого розвитку підприємства. Ці три сценарії враховують умови майбутнього розвитку, які визначаються як песимістичні, оптимістичні та найбільш ймовірні сценарії, що забезпечують збалансований сталий розвиток. Розрахунки стратегічних сценаріїв сталого розвитку базувалися на визначенні порогових значень показників для трьох компонентів: економічної (включаючи якість корпоративного управління), екологічної та соціальної складових. Для кожного зі сценаріїв розроблено стратегічні орієнтири.

У ході дослідження було зроблено висновок про недоцільність розрахунку інтегрального індексу сталості для всього ланцюга постачання в цілому. Такий розрахунок не має інформаційної цінності і технічно практично неможливий через непорівнянність показників різних бізнес-одиниць, що входять до ланцюга поставок. Запропоновано оцінювати сталість бізнес-одиниць в ланцюзі постачання та здійснювати координацію їх стратегій сталого розвитку.

Запропоновано організаційно-економічний механізм управління сталістю ланцюга постачання у гібридній формі, який передбачає поєднання децентралізованої розробки стратегій сталого розвитку окремими підприємствами й організаціями в межах ланцюга постачання та централізованої координації і моніторингу виконання стратегії фокусної компанії на основі цифрової платформи. Концепція цього механізму заснована на мережевому підході і передбачає організацію співпраці учасників ланцюга постачання із залученням широкого кола зацікавлених сторін.

Визначено основні напрямки застосування сучасних цифрових технологій в управлінні сталістю ланцюгів постачань.

Ключові слова: ланцюг постачання, мережі постачання, управління сталістю ланцюга постачання, сталий розвиток промислових підприємств, індикатори сталого розвитку, організаційно-економічний механізм управління сталістю ланцюга.

Мария Григорак, Наталия Трушкина, Екатерина Китриш. «***Организационно-экономический механизм стратегического управления устойчивостью цепей поставок промышленных предприятий".*** *В статье развиты теоретико-методологические основы организации стратегического управления устойчивостью цепей поставок промышленных предприятий. Рассмотрена эволюция концепций управления цепью поставок с позиций институционной теории, а также определено влияние различных факторов на их развитие и интеграцию с концепцией устойчивого развития. Разработан концептуально-категориальный аппарат исследования управления устойчивостью цепей поставок с позиций теории сетей и теории заинтересованных сторон.*

На примере металлургического предприятия предложена система показателей устойчивого развития и определены стратегические ориентиры для трех сценариев устойчивого развития предприятия. Эти три сценария учитывают условия будущего развития, которые определяются как пессимистические, оптимистичные и наиболее вероятные сценарии, обеспечивающие сбалансированное устойчивое развитие. Расчеты стратегических сценариев устойчивого развития базировались на определении пороговых значений показателей для трех компонентов: экономической (включая качество корпоративного управления), экологической и социальной составляющих. Для каждого из сценариев разработаны стратегические ориентиры.

В ходе исследования было сделано заключение о нецелесообразности расчета интегрального индекса устойчивости для всей цепи поставок в целом. Такой расчет не имеет информационной ценности и технически практически невозможен из-за несравнимости показателей различных бизнес-единиц, входящих в цепь поставок. Предложено оценивать постоянство бизнес-единиц в цепи поставок и координировать их стратегии устойчивого развития.

Предложен организационно-экономический механизм управления устойчивостью цепи поставок в гибридной форме, предусматривающий сочетание децентрализованной разработки стратегий устойчивого развития отдельными предприятиями и организациями в рамках цепи поставок и централизованной координации и мониторинга выполнения стратегии фокусной компании на основе цифровой платформы. Концепция этого механизма основана на сетевом подходе и предполагает организацию сотрудничества участников цепи поставок с привлечением широкого круга заинтересованных сторон.

Определены основные направления применения современных цифровых технологий в управлении устойчивостью цепей поставок

Ключевые слова: цепь снабжения, сети снабжения, управление постоянством цепи снабжения, устойчивое развитие промышленных предприятий, индикаторы устойчивого развития, организационно-экономический механизм управления постоянством цепи.

Introduction. Supply chains are an integral part of modern business in a globalized economy. The development of globalization has gradually led to a change in the format of competition: today in global and increasingly national markets compete not individual companies that provide retail chains, mass consumers or industrial customers with specific goods or services, and integrated supply chains. The global economy and, consequently, the business environment continue to evolve under the influence of modern megatrends, including climate change, resource scarcity, and the transformation of consumer preferences, accompanied by increasing demands on goods and services for environmental and social standards. Under the influence of these

megatrends, the institutional environment of companies and their networks is changing, creating integrated supply chains. As a result, meeting the requirements of sustainable development becomes a key factor in competitiveness and a strategic goal of managing both the companies themselves and their supply chains.

However, the implementation of sustainable business practices in supply chain management requires the development of the necessary methodological and methodological support for relevant processes. This task is the integration of two concepts: sustainable development and supply chain management. These concepts are under development, and their supporters have conflicting views on certain basic provisions, including the conceptual and categorical apparatus. This indicates the increased complexity of the scientific substantiation of a holistic and consistent concept of sustainability of supply chain management.

Literature and researches review. Methodological, methodological and practical aspects of the formation of institutional and organizational conditions for the dissemination of practices of social responsibility of business entities, as well as the achievement of sustainable development in the environmental, economic and social dimensions at the global, macro, meso and microlevels are devoted to the works of such scientists as O. Amosha [1], I. Bulyeyev [2], B. Danylyshyn [3], O. Hrishnova [4], A. Kasych [5], Yu. Kharazishvili [6], C. Kroll [7], O. Lyakh [8], V. Lyashenko [9], K. Murphy [10], D. Myers [11], Yu. Pohorelov [12], R. Sroufe [13], G. Unruh [14], V. Vyshnevskyi [15], M. Zhurovskyi [16] et al.

The following foreign and domestic scientists have made a significant contribution to improving the management of economic processes based on the logistics approach, in particular by developing the concept of supply chain management of industrial enterprises and other economic activities: S. Chopra [17], N. Chornopyska [18], M. Christopher [19], N. Chukhray [20], M. Cooper [21], M. Habib [22], O. Hirna [23], M. Hugos [24], T. Kolodizieva [25], Ye. Krykavskyy [26; 27], D. Lambert [28], P. Meindl [17], D. Mentzer [29], H. Min [30], M. Müller [31], R. Oliver [32], S. Seuring [31], J. Stock [33], M. Webber [32], A. Wieland [34] et al.

Aspects of integrating sustainable business practices into supply chain management and the formation of more or less established (in various interpretations: "socially inclusive", "green", "reverse", "low carbonized") supply chains are studied by J. Henderson [35], N. Oelze [36], Y. Rasool [37], J. Sarkis [38], R. Sroufe [39], D. Zimon [40] et al.

Substantiation of the need to organize network forms of interaction of participants in sustainable supply chains, ensuring the implementation of focal (central in the supply chain) monitoring and coordination in this process, identifying a wide range of stakeholders in the supply chain and cooperation with them is contained in the works of scientists such as M. Fritz [41], S. Seuring [42], H. Winkler [43] et al.

The issue of using digital technologies in supply chain management is considered by P. Berttram [44], F. Kache [42], W. Kersten [45], K. Kettunen [46], A. Kwilinski [47], J. Marmolejo-Saucedo [48], E. Ndzibah [46], S. Rana [49], A. Shamsuzzoha [46], S. Schrauf [50], Yu. Zaloznova [51; 52; 53] et al.

Despite the large number of works on the concept of sustainability of supply chain management, its further development is at the stage of substantiating the need for this area of management, defining the conceptual and categorical apparatus, and research on important aspects of implementing this concept in business management practice is fragmentary. There is no holistic vision of the management system that ensures the formation and functioning of a network of economic entities that make up a single supply chain, on the basis of sustainable business. There is a lack of scientifically sound recommendations on mechanisms for integrating supply chain sustainability management into the strategic business

management system. The conceptual provisions of the organizational and economic mechanism of strategic management of the sustainability of supply chains of industrial enterprises with the use of digital technologies need to be developed.

Aim and objectives. The purpose of this article is to develop theoretical and methodological and scientific and practical provisions for improving the strategic management of sustainability of industrial supply chains by introducing organizational and economic management mechanism based on a network approach and involving a wide range of stakeholders in mutual coordination of strategic decisions. standards for sustainable development, with the organization of further monitoring of the achievement of these standards, periodic assessment of the level of sustainability of enterprises and organizations included in the single supply chain, and the use of opportunities provided by modern digital technologies.

The methodological basis of this study are:

the evolutionary paradigm of the new institutional theory, according to which the evolution of the concept of sustainability of supply chains and the practice of existing supply chains that are transformed into steel, considered in conjunction with the changing institutional environment of business;

network theory, according to which supply chains are considered as inter-business networks of enterprises and organizations involved in the formation of value (value) and its provision to the final consumer;

stakeholder theory, based on which the development of organizational and economic mechanism of strategic management of sustainability of supply chains takes into account the need to establish mutually beneficial relations between business and stakeholders whose interests are related to the sustainability of a particular supply chain;

methodological approach to the selection of non-financial reporting indicators, adopted by the Global Reporting Initiative (GRI) and the UN Global Compact, which defines a system of sustainable development indicators that reflect the state of its components (ESG): environmental, social and economic (including the quality of corporate risk management).

The information base of the study is laws and regulations of Ukraine, data of the State Statistics Service of Ukraine, open reporting of enterprises, materials of scientific periodicals, monographs, analytical materials, reports, publications on the Internet of international organizations and consulting firms, other reference sources.

The main material and results of the research. Based on the generalization of literature sources, materials of consulting agencies and the results of their own research [54-61], it is established that the organizational and economic mechanism for managing the sustainability of supply chains can take three forms: centralized, when the focal company undertakes to develop strategies and tactical measures to ensure sustainable development supply chain; decentralized, when sustainable development strategies and tactical plans are developed by each participant in the chain separately, and the focal company on the basis of reporting information assesses the compliance of indicators of a participant in the chain to its requirements; hybrid, when strategic documents are developed by each participant in the chain separately, but then they are agreed with the focal company, which then monitors their implementation. The choice of the form of the mechanism depends on the characteristics of the product or service produced or provided by the focal enterprise, the nature of relations with suppliers and so on.

A hybrid form of this mechanism has been developed for a metallurgical enterprise (Fig. 1).

The essence of the proposed organizational and economic mechanism for managing the sustainability of supply chains is that according to the network approach,

the focal company carries out coordination and control actions in relation to its direct suppliers and intermediaries (first tier companies).

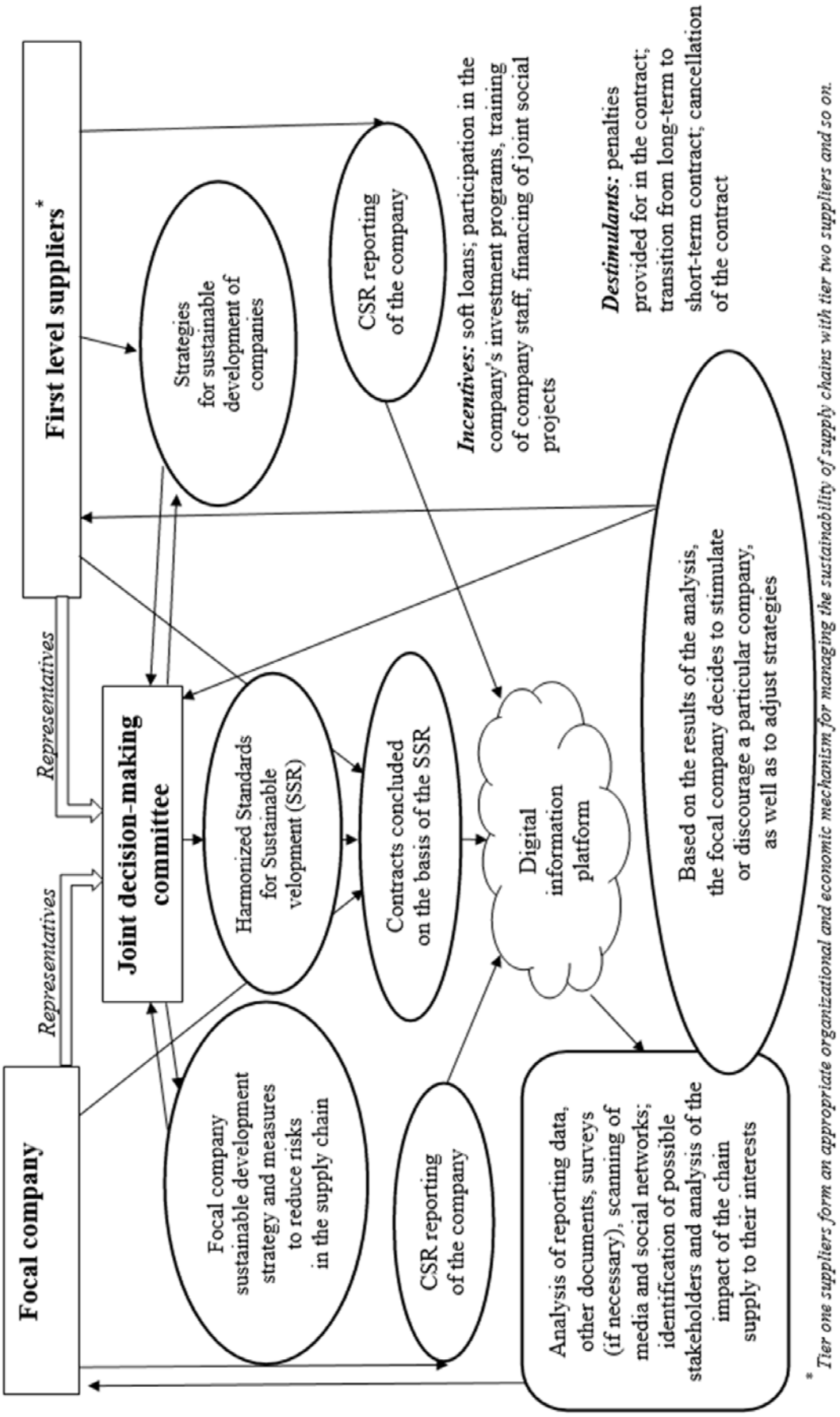

Figure 1 – Organizational and economic mechanism for managing the sustainability of supply chains of metallurgical enterprises (built by the authors on the basis [62-69])

In turn, the companies of the first level of the chain carry out coordination and control actions concerning the companies of the second level for which this company plays the role of focal, and so on. Meetings of the joint committee consisting of representatives of the focal company and its direct suppliers and intermediaries are held periodically to inform the latter about the sustainable development strategy adopted by the focal company, its implementation and harmonization of requirements (standards) for suppliers, their strategy.

Necessary for control and decision-making information on strategic documents, reports, analysis of the degree of compliance of supply chain participants with the established standards of sustainable development (SSD) is accumulated on a specially created digital platform.

SSD contain the following characteristics:

1) Environmental component:

- the volume of emissions of pollutants into the atmosphere, including CO2;
- the amount of solid waste generated;
- share of recycled or transferred to third-party organizations for recycling waste;
- volume of disposed production waste;
- norms of total consumption of drinking and technical water;
- volume of discharge of polluted waters into surface water bodies, including untreated ones;
- the amount of harmful substances in the effluent;
- electricity consumption per unit of main products;
- electricity consumption per UAH 1 million of manufactured products;

2) Social component:

- the share of wages in the issue;
- the ratio of the average at the enterprise and the official minimum wage;
- the level of compliance of workplaces with the established sanitary and hygienic norms;
- costs of the enterprise for social purposes;
- the company's costs for social purposes in relation to profits (in annual terms);

3) Economic component:

- annual sales;
- the level of return on sales and return on equity;
- indicators adopted to assess the risk in the enterprise;
- indicators on the basis of which the level of threat of bankruptcy of the enterprise is forecasted.

The digital platform collects all the necessary statistical information to assess the state of sustainable development by its components and obtain an integrated assessment (integrated index) for each enterprise participating in the supply chain according to the methodology of identification and strategy developed at the Institute of Industrial Economics. The results of approbation of the methodology for assessing the level of sustainable development at four large metallurgical enterprises, which proved the feasibility and feasibility of its use in the management of sustainability of supply chains. This assessment must be performed separately for each entity in the supply chain. Of particular interest may be the attempt to make such an assessment for the supply chain as a whole in order to determine the dynamic changes in the state of chain stability. However, an analysis of the conditions and possible usefulness of such an assessment shows that attempts to assess the level of sustainable development of the supply chain in general are impractical and almost impossible. The reasons for this are as follows:

different enterprises and organizations have different indicators of environmental and social impact, especially when they are calculated per unit of output, which is incomparable for different enterprises, so it is impossible to integrate these indicators;

many suppliers and intermediaries interact not only with a given focal company and supply products and services not only within a given supply chain, so it is unrealistic to determine, for example, what percentage

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of CO2 emissions in a logistics company that serves many customers falls on this supply chain;

assessing the level of sustainable development of the supply chain generally does not carry a meaningful information load for further decision-making, as it is average.

Based on this, it is advisable to use such an assessment (at least once a year) only in the format of individual enterprises and organizations in the chain. Evaluation results after analysis by an authorized structural unit or a specially created group of specialists from a focal company (for example, for PJSC "MK "Azovstal" it may be a joint group of analysts from the Directorate of Labor Protection, Industrial Safety and Environment, Personnel and Administration Directorate, analysis and management of safety risks), together with analytical conclusions are submitted to the Joint Decision Committee on Sustainability of Supply Chains, which decides on the extension of the contract with a particular participant in the chain, stimulating or discouraging it according to the evaluation results.

The digital platform should also be a platform for providing relevant training and instructional materials, collecting and analyzing the proposals of other stakeholders, including communities in the locations of business, communication with the public.

An important point in ensuring the effectiveness of the organizational and economic mechanism for managing the sustainability of supply chains is its integration into the overall management system of both the focal company and other companies in the supply chain. As a result of the conducted research the place of management of constancy of supply chains in the framework structure of management systems of the enterprises which are a part of a chain is defined. The following blocks are included in this structure:

Business strategies of companies participating in the supply chain;

Strategies for sustainable development of companies participating in supply chains;

Operational plans of companies participating in supply chains, including tasks for the implementation of sustainable development strategies;

Activities during the life cycle of the supply chain: planning; provision; production; delivery; return; processing; repair, update;

Functions that support the development of supply chains: relationship management with suppliers; forecasting supply and demand; inventory management; distribution and logistics management; customer relationship management and service; environmental management; waste management; integration of social responsibility practices into management processes;

Change management;

Performance evaluation;

Enterprise management subsystems that interact with supply chain management subsystems: HR; company sustainability management; risk management; information system management; enterprise infrastructure management;

Supply chain environment: investors; regulatory authorities; social movements, non-governmental organizations; local communities; business associations; Mass media;

Supply chain participants: suppliers; manufacturers; distributors; trade networks; consumers; waste processors.

The key in this context is that the sustainable development strategies of the companies involved in the supply chain should be incorporated into the overall business strategies of the focal company and all other participants in the supply chain, on the basis of which operational plans are developed and implemented. It is also important to involve a wide range of stakeholders in all these processes.

As for the Metinvest Group, it is a network structure that integrates several supply chains. Therefore, the proposed organizational and economic mechanism and structural relationships of the supply chain sustainability management system can be

fully implemented in the Group's management system.

The top executive level of Metinvest Group management is represented by 10 directorates: operational, financial, economics and business system development, logistics and procurement, sales, technical management, sustainable development and cooperation with colleagues, legal support, information technology, internal audit.

One of the strategic goals of the Metinvest Group is to ensure a competitive advantage in steel production. Centralization of procurement and implementation of common procurement standards serve this purpose. These functions belong to the sphere of management of the Logistics and Procurement Directorate, which includes the Marketing and Procurement Strategy Department, the Strategic Raw Materials Procurement Department, and the Energy Procurement Department.

More than 80% of all consumed materials, equipment and services are procured by the Logistics and Procurement Directorate centrally for all Metinvest Group companies. The main focus of Metinvest Group's procurement strategy is to create and maintain a healthy and competitive environment. Metinvest Group's initiatives are aimed at constantly expanding the number of participants in tender procedures to find the most reliable suppliers and build long-term cooperation.

Refractories supplied by the Zaporizhzhya Refractory Plant (Zaporizhvozhnetriv) are used for the production of metallurgical and coke-chemical products. The Group provides four main mining and processing enterprises with iron ore: Central GOK, Northern GOK, Ingulets GOK, and Southern GOK. Coal for coke production is supplied by the American company UCC United Coal Company, as well as the Pokrovsky Coal Group. Slabs, hot-rolled and cold-rolled sheets of enterprises of PJSC "MK Azovstal", PJSC "MMK them Ilyich" are delivered to the rolling plants "Promet Steel" (Bulgaria), Spartan UK (UK), Trametal (Italy), Ferriera Valsider (Italy). Zaporizhstal hot-rolled and cold-rolled sheets are supplied to Unistil.

Management of the implementation of development strategies and coordination of actions of all participants in the supply chain in the Metinvest Group is carried out using the CRM system. CRM is software designed to automate customer engagement strategies, including sales, optimize marketing, and improve customer service by storing customer information and customer history, establishing and improving ordering processes, and further analyzing results. CRM is a model of interaction based on the theory that the center of the entire business philosophy is the customer, and the main activities of the company – measures to ensure effective marketing, sales and customer service. Supporting these business goals includes collecting, storing and analyzing information about consumers, suppliers, partners, and the company's internal processes. Functions to support these business goals – sales, marketing, customer support. The CRM system implemented in the Metinvest Group is based on the innovative cloud platform SAP Sales Cloud and consists of two modules: Customer (Cloud for Customer, C4C) and Configure Price Quote (CPQ). SAP Sales Cloud is the largest project to implement this cloud platform in Ukraine, and the CPQ module is the only online product catalog that has the ability to create individual orders for customers. It also systematizes the process of providing discounts, calculating final prices, logistics costs and other costs to provide the best customer service. In 2021, the Metinvest Group continues to develop CRM, including through the implementation of planning, adding products to the configuration, etc. based on user feedback. The company also plans to start distributing modules to other trading companies in Ukraine, Belarus and Western Europe.

According to the Metinvest Group's procurement rules, the supplier may be disqualified for a certain period or indefinitely

in the event of unfair business with the Group's companies. The decision to disqualify a supplier or resume work with a previously disqualified supplier is made by the Metinvest Group's Supplier Cooperation Council. The Council has the right to decide on the disclosure of information on the reasons for disqualification of the supplier.

The following criteria are used to decide on the disqualification of a supplier:

systematic supply of low-quality goods, works, services; supply of counterfeit products;

disruption of terms of delivery of goods, works, services;

violation of labor protection and safety rules on the territory of Metinvest Group enterprises;

refusal to sign a standard supply contract, if this was a prerequisite for the supplier selection procedure;

refusal to sign the specification to the supply contract after the submission of the final price offer (within the tender, competitive processing);

violation of the principle of ethical and open business, including collusion between suppliers to increase or maintain unreasonable prices for goods, works and services;

attempted bribery of Metinvest Group employees;

low level of supplier evaluation based on the results of the year; other criteria (by decision of the Council for interaction with suppliers).

The reasons and the fact of disqualification are entered into the Unified database of suppliers of Metinvest Group and are taken into account in the general history of work of the supplier at all enterprises of Metinvest Group.

The introduction of sustainable development practices and ESG criteria into the activities of the Metinvest Group at all levels will contribute to business stability. This approach will be one of the factors in maintaining the Group's high performance, despite adverse environmental conditions. The group

Metinvest needs not only to strive to integrate the ESG agenda into the strategy, but also to carry out internal ESG transformation, as well as use its unique role and opportunities to create and improve the regulatory environment in the field of ESG, develop and implement best practices.

In order to form a unified approach to sustainable development management and ESG, as well as for the effective implementation of the ESG Strategy, it is necessary to establish an ESG Committee and the ESG Directorate. In addition, an ESG supervisor on the Supervisory Board and a senior vice president will be appointed to be responsible for the ESG order on the board.

The Strategic Planning Committee of the Supervisory Board should be renamed the Strategic Planning and Sustainable Development Committee with the corresponding expansion of its functions. Then the organizational structure of sustainable development management and ESG in the Metinvest Group will be in line with best practice and will cover all levels of government.

The ESG Committee is a working body dedicated to ensuring compliance with the principles of sustainable development and ESG in ecosystem companies. The ESG-Committee should include representatives of all functional units and territorial enterprises of the Metinvest Group, which consider topical issues of sustainable development and ESG at regular meetings.

Within the ESG-committee it is necessary to form thematic working groups that systematize the work in such areas as risk management, practical environment, social decisions, responsible procurement. The work of the ESG-committee will allow to start monitoring the main suppliers according to ESG-criteria.

The ESG Directorate is a key body that will coordinate activities in the field of sustainable development and the ESG. He is responsible for developing and implementing a single,

comprehensive approach to sustainable development and the ESG, which takes into account the interests of all stakeholders, best practices, commitments and goals of the Metinvest Group, traditional and already implemented programs and projects.

To achieve this goal, the ESG will perform the following interrelated tasks:

methodology and management of information flows (Data Management): consolidation of ESG-data and work with them, methodological support of activities, implementation of ESG-standards;

ESG-positioning: presentation of ESG-positions of Metinvest Group on international platforms and investment forums, preparation and holding of targeted events, participation in ESG-ratings, communication support of ESG-initiatives;

GR (government relations) – interaction with public authorities in the field of ESG and coordination of ESG projects: participation in the formation of the regulatory framework of ESG in Ukraine, examination of proposals and replication of best practices, formation of ESG portfolio, consulting on ESG.

In addition to internal governing bodies, Metinvest Group will consolidate its expert and business community to formulate and implement a progressive ESG agenda at the national level. In 2021, the Metinvest Group should develop a policy on sustainable development and ESG criteria, which will establish the main approaches, principles, directions and tasks of the Group in this area, as well as set an approach to interaction with stakeholders. Policy development will be discussed with internal and external stakeholders at the board and supervisory board level.

The Sustainable Development Policy will complement the ESG Strategy, and together they will define the approach, main priorities and goals in the field of ESG until 2023. In managing sustainable development and ESG criteria, including in policy development, it is necessary to analyze and take into account the requirements of international standards. recommendations, as well as best practices of industry companies. Metinvest Group should integrate the ESG Strategy into the overall corporate development strategy until 2023. To formulate the directions and goals of the ESG Strategy, an analysis of standards and best practices, inventory and systematization of current initiatives in the field of sustainable development and ESG was performed.

Key Areas and Objectives of the Metinvest Group's ESG 2021-2023 Strategy:

– increase the share of waste for processing to 40% by 2023;

– increase the share of "green" energy to 30% by 2023;

– calculation and reduction of carbon footprint;

– making 100% of purchases according to ESG criteria;

– development of regulatory framework for the classification of ESG risks and environmental footprint assessment;

– development of comfortable environmental conditions and care for the health of employees and their families in the areas of presence;

– providing flexible work formats for more than 20% of employees;

– maintaining the index of employee involvement at 75%;

– adoption of an industry standard;

– formation of standards of care for the employee and social decisions at the level of the whole country;

– development of educational technologies;

– development of ESG-policy and creation of ESG-risk management system.

Metinvest Group needs to develop a single ESG risk management system, which will be integrated into the overall risk management system. ESG risk is a component of Metinvest Group's high or medium level risks. Working groups need to develop their own expert approaches to integrated Group ESG risk management, including through the development of tools to identify such risks, develop an ESG rating system, and modernize all processes through the integration of ESG

factors, ESG risk monitoring and stress testing under the influence of ESG factors. ESG risks of Metinvest Group:

changes in legislation – untimely adaptation to changes in national and international legislation;

reputational – the probability of reputational losses in the case of ESG-risks;

operational – the probability of late and / or insufficient adaptation of processes to all significant ESG factors;

behavior – losses due to non-compliance with good business practices;

strategic – losses due to changes in consumer models under the influence of ESG-factors and lack of adaptation measures;

investment – change in the value of assets due to ESG factors and reduced investment yield;

model – insufficient introduction of ESG-factors in the current model, the need to develop new models;

liquidity – the potential outflow of liquidity due to the reaction to the violation of the principles of responsible financing, which is realized through the associated risks.

As part of a long-term strategy for the development of zero-emission steel production, the Metinvest Group intends to increase the sustainability of its production facilities and is interested in introducing new technologies to reduce environmental impact. In July 2021, memoranda of cooperation were signed with the international leader in the field of engineering, construction and provision of services for the entire life cycle of equipment of metallurgical enterprises Primetals Technologies and the leading Austrian research center in metallurgy K1 – MET.

In a memorandum with Primetals Technologies, the parties agreed to implement joint projects on sustainable development of the industry. These include research initiatives funded by Horizon Europe and the Coal and Steel Research Fund on climate and environmental issues in the steel industry. The cooperation includes work on technological solutions that can be implemented at Metinvest Group's production facilities, as well as on promising technologies and solutions for the entire supply chain of the metallurgical and mining industries to accelerate the decarbonization process in the Group. Areas of mutual interest include energy-efficient and innovative DRI-based steel production, capture, utilization of carbon and metallurgical gas.

As a result of the study, three scenarios for the sustainable development of the industrial enterprise of PJSC MK Azovstal until 2027 were developed:

realistic – reaching the average level between the lower threshold and lower optimal values, which is ensured by an annual growth of 5%. At the same time, the real output in 2010 prices is 81.3% of the 2010 output level;

optimistic – reaching the level of the lower optimal value (entering the optimal zone of the EU), which is ensured by an annual growth of 7%. At the same time, the real GRP in 2010 prices in 2027 is 94.5% of the GRP level in 2011;

balanced sustainable development – achieving a full level of sustainable development – the average between the lower and upper optimal values (criterion of sustainable development), which is ensured by an annual growth of 10%. At the same time, the real output in 2010 prices in 2027 is 117.9% of the 2010 output level.

Development of scientifically sound strategic scenarios of sustainable development of industrial enterprises is based on a new methodology of identification and strategy developed at the Institute of Industrial Economics of NAS of Ukraine, based on consistent decomposition of integrated indices by solving the inverse problem using adaptive control procedure in C ++ programming language.

The strategic guidelines of key macro indicators have been identified, which together with the strategic values of indicators are the ultimate goal of regulating sustainable development. They can be monitored through monitoring to monitor

the implementation of development strategies and evaluate enterprise management policies.

Disproportions of sustainable development at the level of economic, social and environmental security of the enterprise, subordinate components and at the level of indicators that determine the list of major threats, which according to calculations are indicators of social and economic components of sustainable development.

The organizational and economic mechanism of management of constancy of supply chains constructed taking into account network character of supply chains is offered. The need to involve a wide range of stakeholders in this management process is identified, as well as the scheme of integration of sustainability management of supply chains as a subsystem into the overall management systems of enterprises in the chain.

The stages of digital transformation of supply chain sustainability management, the main directions of digital technologies implementation in this management process are determined; prospects and obstacles to the introduction of blockchain technology in supply chain management as the most technologically and organizationally developed for this purpose are analyzed.

Conclusions. In this paper the actual problem of strategic management of sustainability of supply chains of industrial enterprises is solved. The main scientific and methodological results obtained during the study allowed us to draw the following conclusions.

It is determined that the emergence and evolution of the concept of supply chain management is due to the development of globalization, in particular the spread of global competition, when competing with each other were not so much individual companies as whole supply chains. In the future, the evolution of supply chain management in relation to its integration with the concept of sustainable development began to be influenced by the transformation of the institutional environment, strengthening the requirements for greening production, compliance with certain social standards.

It is proved that a significant evolution has also taken place in the practice of sustainable business development, in particular in the relationship between its economic (financial) and two other components – environmental and social. Traditionally, in the academic literature and business practice, these components were considered to be somewhat conflicting (especially between the cost of reducing environmental impact and financial and economic performance). It is substantiated that the introduction of sustainable business practices in companies leads to increased competitiveness, profitability and market value of these companies under the influence of changes in the institutional environment of business, including strengthening regulatory requirements and changes in consumer preferences in favor of goods and services. who behave as environmentally and socially responsible.

As a result of generalization of scientific publications, analytical materials of consulting firms, conclusions of experts in the field of supply chain management, it is established that a sustainable supply chain should be considered as a network of enterprises and organizations that create value and bring it to the end consumer and other stakeholders. Sustainability of supply chains – as a set of processes for strategic planning, monitoring and control of all activities in this network of enterprises and organizations on how they adhere to the principles and rules of socially responsible business behavior and achieve appropriate standards of sustainable development set by the focal company and agreed with its counterparties.

Based on the methodological approach of the Global Reporting Initiative (GRI) and the UN Global Compact, a system of sustainable development indicators has been identified. It is proved that in order to assess the state of

industrial enterprises and develop strategies for their sustainable development, it is necessary to calculate the threshold values of the relevant indicators of sustainable development. Vectors of such threshold values for metallurgical enterprises are calculated.

As a result of determining the dynamics of integrated indices of sustainable development of metallurgical enterprises of Ukraine and developing three scenarios for sustainable development of the metallurgical plant "Azovstal" until 2027 based on the methodology of evaluation and strategy using a modified rationing method and dynamic weights developed by Yu. Kharazishvili [70] the possibility of applying this methodology for the organization of strategic sustainability management within the metallurgical supply chain.

The necessity of introduction into the practice of sustainable development management of Metinvest Group on the basis of ESG-criteria of the system of risk assessment indicators at all levels is substantiated, which will promote stable business development. This approach will be one of the factors maintaining the Group's high financial and economic performance, despite adverse environmental conditions.

It is proved that the design of organizational and economic mechanism of strategic management of supply chain sustainability in modern conditions should take into account their network nature and connection with a wide range of stakeholders, including communities in business locations, especially large companies with significant urbanization. It is substantiated that such a mechanism should be formed on the basis of cooperation of all participants in the supply chain, mutual coordination of strategic decisions between them, development of appropriate standards for sustainable development with maximum regard to the legitimate interests of stakeholders. An essential element in the functioning of such an organizational and economic mechanism, which creates conditions for the development of a strategy for sustainable development of enterprises within the single supply chain, their implementation and control over the achievement of established indicators and standards, is a specially created digital information platform.

The expediency of using digital technologies in the management of the sustainability of supply chains in the following areas: big data analytics, blockchain, artificial intelligence and machine learning, digital duplicates. Among them, blockchain technology is currently the most prepared for practical application and increases the reliability of the supply chain. This technology can not only ensure open data on compliance with agreed standards of sustainable development in the implementation of contracts, but also strengthen trust between partners in the supply chain and reduce the time and cost of transactions.

Prospects for further research are to substantiate and develop conceptual provisions for the formation and development of green supply chain management in the context of the concepts of circular economy and sustainable development..

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