

Electronic scientific and practical journal

INTELLECTUALIZATION OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT

#2 (2020)
July '20



WWW.SMART-SCM.ORG

ISSN 2708-3195

[DOI.ORG/10.46783/SMART-SCM/2020-2](https://doi.org/10.46783/SMART-SCM/2020-2)

ISSN 2708-3195





Electronic scientific and practical publication in economic sciences

ISSN 2708-3195

DOI: <https://doi.org/10.46783/smart-scm/2020-2>

Released 6 times a year

№ 2 (2020)
July 2020

Kyiv - 2020

Founder: Viold Limited Liability Company

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

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

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

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

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

Members of the Editorial Board:

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

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

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

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

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

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

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

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

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

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

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

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

SMERICHEVSKA S. V. – Doctor of Economics, Professor;

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

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

PATKOVSKYI S. A. – Business practitioner.

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

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

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

t.me/smart_scm
facebook.com/Smart.SCM.org
twitter.com/ScmSmart

DOI: <https://doi.org/10.46783/smart-scm/2020-2>
e-mail: support@smart-scm.org

тел.: (063) 593-30-41
<https://smart-scm.org>

Contents

INTRODUCTION	6
GRITSENKO S.I. Doctor of Economics, Professor, Professor of Logistics Department National Aviation University (Ukraine), KARPUN O.V. PhD of Economics, Associate Professor, Associate Professor of Logistics Department National Aviation University (Ukraine) <i>CREATION OF AVIATION TRANSPORT AND LOGISTIC CLUSTERS NETWORK</i>	7 – 15
KOSTYUCHENKO L.V. PhD (Economics), Associate Professor, Associate Professor of Logistics Department National Aviation University (Ukraine), KOSTIUCHENKO A.V. lieutenant-colonel Armed Forces of Ukraine, Kyiv, (Ukraine) <i>THE LOGISTICAL SUPPORT SYSTEM ELEMENTS FOR THE PREPAREDNESS FOR MILITARY OPERATIONS</i>	16 – 31
MARCHUK V.Ye. Doctor of Engineering, Associate Professor, Professor of Logistics Department National Aviation University (Ukraine), HARMASH O.M. PhD (Economics), Associate Professor, Associate Professor of Logistics Department National Aviation University (Ukraine), OVDIENKO O.V. PhD student, Assistant at Logistic Department at National Aviation University (Ukraine) <i>WORLD TRENDS IN WAREHOUSING LOGISTICS</i>	32 – 50
PATKOVSKYI Sergii Business practitioner; Business development manager, emerging markets Kuehne + Nagel Inc., Chicago, IL (USA), LYTVYENKO S.L. PhD (Economics), Associate Professor, Associate Professor of International Economics Department National Aviation University (Ukraine) <i>THE WAYS OF SUPPLY CHAIN RESPONSIVENESS INCREASE AT TIME OF PORT INFRASTRUCTURE AND TRANSPORTATION ASSETS PRODUCTIVITY DISRUPTION</i>	51 – 64
POPOVYCHENKO I.V. Doctor of Economic, Professor, Head of Economics and Entrepreneurship Department State Higher Educational Establishment "Prydniprov's'ka State Academy of Civil Engineering and Architecture", Dnipro, (Ukraine), SPIRIDONOVA K.O. PhD (Economics), Associate Professor, Associate Professor of Economics and Entrepreneurship Department State Higher Educational Establishment "Prydniprov's'ka State Academy of Civil Engineering and Architecture", Dnipro, (Ukraine) <i>APPLICATION OF FUNCTION COST ANALYSIS AND NETWORK SCHEDULING IN LOGISTICS COST MANAGEMENT</i>	65 – 77

KOLOSOK V.M. Doctor of Economic, Professor, Head of the Department of Transport Management and Logistics Department Priazovsky State Technical University (Ukraine), **LAZAREVSKA Yulianna.** PhD student Donetsk National Technical University (Ukraine)

EFFICIENCY OF DIGITAL COMMUNICATIONS IN THE LOGISTICS BUSINESS: EVALUATION INDICATORS

78 – 87

CHORNOPYSKA N.V. PhD (Economics), Associate Professor, Associate Professor at department marketing and logistics at Lviv Polytechnic National University (Ukraine), **BOLIBRUKH L.I.** Student at department marketing and logistics at Lviv Polytechnic National University (Ukraine)

THE INFLUENCE OF THE COVID-19 CRISIS ON THE FORMATION OF LOGISTICS QUALITY

88 – 98

KOISHYNSKA K. O. PhD (Economics), Senior Lecturer of Department of Management, National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" (Ukraine)

CURRENT STATE AND PROSPECTS OF DIGITAL TRANSFORMATION OF THE TRANSPORT AND LOGISTICS SECTOR OF UKRAINE

99 – 110

HRYHORAK M. Yu.., Doctor of Science in Economics, Associate Professor, Head of Logistics Department of National Aviation University (Ukraine), **KARPENKO O.O.**, Doctor of Science in Economics, Professor, Professor by Water Transport Management and Economics Department, State University of Infrastructure and Technologies (Ukraine), **SEMERIAHINA M. M.**, Senior Lecturer of Logistics Department of National Aviation University (Ukraine)

FORMATION OF THE MULTIMODAL TRANSPORT ECOSYSTEM IN UKRAINE

111 – 130

The History of Science.

MIROTIN Leonid Borysovych – the Doctor of Technical Sciences, Professor

131 – 135

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 discuss 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.

HRYPHORAK Mariia
Chief Editor



UDC 338.3

DOI: <https://doi.org/10.46783/smart-scm/2020-2-1>

JEL Classification: C38, L14, L93, O18.

Received: 21 July 2020

Gritsenko S.I. Doctor of Economics, Professor, Professor of Logistics Department National Aviation University (Ukraine)

ORCID – 0000-0002-3322-3986

Researcher ID – N-4298-2018

Scopus author id:

Karpun O.V. PhD of Economics, Associate Professor, Associate Professor of Logistics Department National Aviation University (Ukraine)

ORCID – 0000-0003-2058-9070

Researcher ID – S-6428-2018

Scopus author id:

CREATION OF AVIATION TRANSPORT AND LOGISTIC CLUSTERS NETWORK

Sergiy Gritsenko, Olga Karpun. *«Creation of aviation transport and logistic clusters network». In the transport and logistics systems of the Ukrainian regions, the constituent elements of different types of vehicles, airports, seaports, railway junctions, logistics centers are separated and aimed at achieving individual goals. They do little to achieve common goals, which limits the access of Ukrainian products to the world transport market. The current state of the Ukraine transport system requires research on the formation of aviation transport and logistics clusters. The purpose and objectives of the research are to substantiate the theoretical and methodological foundations and develop practical recommendations for the formation of aviation transport and logistics clusters network as an organizational and economic form of effective interaction of all its participants.*

The intensification of Ukraine's activities on the development of international cooperation in the field of transport services, adaptation of national legislation to EU norms and standards, as well as countries that are members of international associations, has been considered. The main goal for all participants of the aviation transport and logistics cluster is to provide a competitive service to customers with optimal total costs. The network of aviation transport and logistics clusters is considered as a basis for productive cooperation of partners with a balance of conflicts of interest. The peculiarities of the advantages of membership in aviation transport and logistics clusters are identified.

A network of aviation transport and logistics clusters in Ukraine has been proposed, which can be introduced by seven international leading airports – «Lviv» named after Danylo Halytsky, «Dnipro», «Odesa», «Kharkiv», «Kyiv» named after I. Sikorsky (Zhulyany), «Boryspil» (Kyiv) and «Zaporizhzhia International Airport», which serve about 98% of the total passenger, mail and cargo flows and provide six transit routes. The potential of Ukraine's leading international airports has been described. The principles of formation and coordination of management of different types of transport within aviation transport and logistics clusters has been defined: voluntary partnership, innovation, transparency and stability of «rules of the game», multimodality, satellite navigation, intelligent transport systems, information technologies, electronic document management and

corporate social responsibility. The components of the competitiveness of the aviation transport and logistics clusters network in the global environment has been identified in order to create an effective management system for transportation safety and productivity.

The formation of the aviation transport and logistics clusters network as drivers and catalysts for economic development in the regions will allow maximizing the transport potential of Ukraine. This will make it possible to create a customer-oriented system of transport services and obtain a synergy effect from the optimal coordination by the leading airports of potential of all transport modes on the basis of partner-competitive principles during the implementation of traffic.

Keywords: transport and logistics cluster, transport potential, aviation industry, international airport, synergistic effect.

Сергій Гриценко, Ольга Карпунь. «Створення мережі авіаційних транспортно-логістичних кластерів». У транспортно-логістичних системах українських регіонів складові елементи різних видів транспортних засобів, аеропортів, морських портів, залізничних вузлів, логістичних центрів розрізнені і спрямовані на досягнення індивідуальних цілей. Вони мало сприяють досягненню загальних цілей, що обмежує вихід української продукції на світовий транспортний ринок. Сучасний стан транспортної системи України потребує дослідження питань формування авіаційних транспортно-логістичних кластерів. Мета і завдання дослідження полягають в обґрунтуванні теоретико-методологічних основ і розробленні практичних рекомендацій щодо формування мережі авіаційних транспортно-логістичних кластерів як організаційно-економічної форми ефективної взаємодії всіх її учасників.

Розглянуто активізацію діяльності України щодо розвитку міжнародного співробітництва у сфері транспортних послуг, адаптації національного законодавства до норм та стандартів ЄС, а також країн, що входять до міжнародних об'єднань. Визначено основну мету для всіх учасників авіаційного транспортно-логістичного кластера – це надання конкурентоспроможного сервісу клієнтам з оптимальними загальними витратами. Мережа авіаційних транспортно-логістичних кластерів розглядається як основа для продуктивної співпраці партнерів з рівновагою конфлікту інтересів. Ідентифіковано особливості переваг членства в авіаційних транспортно-логістичних кластерах.

Запропоновано мережу авіаційних транспортно-логістичних кластерів в Україні, яку можуть запровадити сім міжнародних провідних аеропортів – «Львів» ім. Данила Галицького, «Дніпро», «Одеса», «Харків», «Київ» ім. І. Сікорського (Жуляни), «Бориспіль» (Київ) та «Міжнародний аеропорт Запоріжжя», які обслуговують близько 98 % загальних пасажиропотоків, пошто-вантажопотоків та забезпечують шість транзитних напрямків. Охарактеризовано потенціал міжнародних провідних аеропортів України. Визначено принципи формування та координації управління різними видами транспорту в межах авіаційних транспортно-логістичних кластерів: добровільної партнерської взаємодії, інноваційності, прозорості та стабільності «правил гри», мультимодальності, супутникової навігації, інтелектуальних транспортних систем, інформаційних технологій, електронного документообігу, корпоративної соціальної відповідальності. Виокремлено складові елементи конкурентоспроможності мережі авіаційних транспортно-логістичних кластерів у світовому середовищі з метою створення ефективної системи управління безпекою перевезень та їх продуктивності.

Формування мережі авіаційних транспортно-логістичних кластерів як драйверів та каталізаторів економічного розвитку в регіонах дозволить максимально використовувати транспортний потенціал України. Це дасть можливість створити клієнтоорієнтовану систему транспортного обслуговування і отримати синергетичний ефект від оптимальної координації провідними аеропортами потенціалу усіх видів транспорту на основі партнерсько-конкурентних засад під час здійснення перевезень.

Ключові слова: транспортно-логістичний кластер, транспортний потенціал, авіаційна галузь, міжнародний аеропорт, синергетичний ефект.

Сергей Гриценко, Ольга Карпунь. «Создание сети авиационных транспортно-логистических кластеров». В транспортно-логистических системах украинских регионов

составляющие элементы различных видов транспортных средств, аэропортов, морских портов, железнодорожных узлов, логистических центров разрозненны и направлены на достижение индивидуальных целей. Они мало способствуют достижению общих целей, что ограничивает выход украинской продукции на мировой транспортный рынок. Современное состояние транспортной системы Украины требует исследования вопросов формирования авиационных транспортно-логистических кластеров. Цель и задачи исследования заключаются в обосновании теоретико-методологических основ и разработке практических рекомендаций по формированию сети авиационных транспортно-логистических кластеров как организационно-экономической формы эффективного взаимодействия всех ее участников.

Рассмотрено активизацию деятельности Украины по развитию международного сотрудничества в сфере транспортных услуг, адаптации национального законодательства к нормам и стандартам ЕС, а также стран, входящих в международные объединения. Определена основная цель для всех участников авиационного транспортно-логистического кластера – это предоставление конкурентоспособного сервиса клиентам с оптимальными общими затратами. Сеть авиационных транспортно-логистических кластеров рассматривается как основа для продуктивного сотрудничества партнеров с равновесием конфликта интересов. Идентифицированы особенности преимуществ членства в авиационных транспортно-логистических кластерах.

Предложено сеть авиационных транспортно-логистических кластеров в Украине, которую могут внедрить семь международных ведущих аэропортов – «Львов» им. Данила Галицкого, «Днепр», «Одесса», «Харьков», «Киев» им. И. Сикорского (Жуляны), "Борисполь" (Киев) и «Международный аэропорт Запорожье», которые обслуживают около 98% общих пассажиропотоков, почто-грузопотоков и обеспечивают шесть транзитных направлений. Охарактеризован потенциал международных ведущих аэропортов Украины. Определены принципы формирования и координации управления различными видами транспорта в пределах авиационных транспортно-логистических кластеров: добровольного партнерского взаимодействия, инновационности, прозрачности и стабильности «правил игры», мультимодальности, спутниковой навигации, интеллектуальных транспортных систем, информационных технологий, электронного документооборота, корпоративной социальной ответственности. Выделены составляющие элементы конкурентоспособности сети авиационных транспортно-логистических кластеров в мировой среде с целью создания эффективной системы управления безопасностью перевозок и их производительности.

Формирование сети авиационных транспортно-логистических кластеров как драйверов и катализаторов экономического развития в регионах позволит максимально использовать транспортный потенциал Украины. Это позволит создать клиентоориентированную систему транспортного обслуживания и получить синергетический эффект от оптимальной координации ведущими аэропортами потенциала всех видов транспорта на основе партнерско-конкурентных основ при осуществлении перевозок.

Ключові слова: транспортно-логістический кластер, транспортный потенциал, авиационная отрасль, международный аэропорт, синергетический эффект.

Introduction. The transport sector is one of the basic sectors of the economy, which creates the necessary preconditions to meet the needs of transport users in the provision of transport services and business development. Ukraine plays the role of a transit bridge connecting the countries of Europe and Asia. There is a differentiated network of direct and transit air connections. Aviation transit through Ukraine is mainly

provided by the Boryspil hub airport [1]. To improve the management of state assets in the aviation infrastructure, it was expedient to create networks of aviation transport and logistics clusters. In our opinion, transport and logistics clusters are naturally interconnected and interdependent parts of the logistics system with the key status of a transport intermediary, which carries out inter-organizational coordination and provides a

synergistic effect [2, p. 118]. The use of the key status of transport intermediary by Boryspil International Airport in the creation of a multimodal transport and logistics cluster will increase its competitiveness as a leading hub airport in Eastern Europe. In particular, it can be done by expanding the network of air connections, attracting more air carriers, creating passenger, freight and logistics infrastructure complexes with rail, road, air and water transport at hub railway stations, ports and airports with inter-organizational coordination of leading airports.

Many foreign and domestic scientists have dedicated their works to solving the problem of ensuring the economic development of transport and logistics enterprises, in particular on the basis of clustering.

The processes of clustering of enterprises and the functioning of clusters in the economy are devoted to the work of world famous scientist M. Porter [3]. This issue is considered in the studies of many other foreign and domestic authors, in particular in the works of M. Voynarenko [4], S. Sokolenko [5] and others.

Despite the depth of scientific research on the problems of clustering, the current state of the transport system of Ukraine requires research on the formation of aviation transport and logistics clusters.

The purpose and objectives of the research. It consists in substantiating the theoretical and methodological foundations and developing practical recommendations for the formation of the aviation transport and logistics clusters network as an organizational and economic form of effective interaction of all its participants.

The main material and results of the research. In Ukraine, there are 19 airports and airfields, which currently operating and servicing commercial flights of domestic and foreign airlines. Passenger traffic through the airports of Ukraine is about 13 million people [6]. The network of aviation transport and logistics clusters in Ukraine can be introduced by seven leading international airports –

"Lviv" named after Danylo Halytsky, "Dnipro", "Odesa", "Kharkiv", "Kyiv" named after I. Sikorsky (Zhulyany), Boryspil (Kyiv) and Zaporizhzhia International Airport, which serve about 98% of the total passenger, mail and cargo flows and provide six transit routes.

The main goal for all participants of the aviation transport and logistics cluster is to provide competitive service to customers with optimal total costs.

The network of aviation transport and logistics clusters is considered as a basis for productive cooperation of partners with a balance of conflict of interests. Advantages of membership in aviation transport and logistics clusters: reducing the risk of loss; the possibility of using best practices; joint creation, implementation of innovations and new initiatives; fastest contacts; high level of partners trust; a tool for counteracting crisis phenomena; the fastest possible interaction with local authorities to agree on priorities for action to reduce the impact of negative economic trends; effective balancing of priorities in the field of transport services; leadership in supporting and stimulating the economy of the regions and the transport industry; better coordination, communication and cooperation of participants and curators – partners of cluster development; quick adaptation to changes.

In the transport and logistics systems of Ukrainian regions, the constituent elements of different types of vehicles, airports, seaports, railway hubs, logistics centers are separated and directed at achieving individual goals, do little to achieve common goals, which limits Ukrainian products to the world transport market. Therefore, to establish strong relationships between the elements of the transport system requires the formation of a "strong" core, which will create conditions for competition and active interaction of participants. Due to the low level of development of transport and logistics technologies, intermodal, multimodal transportation and transport logistics, the transport industry of Ukraine is used insufficiently.

The individual potential of each airport will be used comprehensively in the network of aviation transport and logistics clusters in the process of joint operation of transport and logistics infrastructure.

"Lviv" International Airport named after Danylo Halytskyi [7] is the largest airport in Western Ukraine in terms of passenger traffic and route network, located at a distance of 6 km from the city center to the south. The airport's route network consists of 50 destinations (47 international and 3 domestic).

In 2018, "Dnipro" International Airport celebrated its 100th anniversary. The last reconstruction of airport infrastructure was made in 1996, so now "Dnipro" is preparing for major changes. According to plans, the reconstruction will last until 2022 [8]. The new airport will be able to accommodate up to 3 million passengers a year (now – less than 1 million people a year). The reconstruction project also envisages the construction of a new modern parking for 500 cars, the construction of a new single complex with a VIP-terminal and a passenger terminal with cafes, restaurants and a large Duty free zone.

"Odesa" International Airport is one of the largest airports in Ukraine, a member of the International Air Transport Association (IATA), the International Civil Aviation Organization (ICAO), the International Airport Council (ICI Europe) and the Association of Ukrainian Airports. The passenger terminal, with a total capacity of 400 passengers per hour, is designed to serve international and domestic flights [9]. The aerodrome is equipped with the necessary air traffic control devices and meets all the necessary requirements of the legislation for civil aerodromes of Ukraine.

"Kharkiv" International Airport is the largest air hub in eastern Ukraine. In preparation for the Euro 2012 World Championships, the airport complex underwent reconstruction, which included the construction of a new terminal that meets all modern standards for the international airport, construction of a new runway with a length of 2500 m, reconstruction of the old

terminal, construction and overhaul of the platform and improvement of the station area. Upon completion of the reconstruction, the airport can accept without restrictions aircraft of class A, B and C, and by agreement it can accept aircraft of class D. The airport serves 3 domestic and more than 40 international scheduled and seasonal flights of 15 airlines flying to major cities in Europe and Africa. The annual passenger traffic at the airport has exceeded 1 million people, and it is constantly increasing [10].

"Zaporizhzhia" International Airport is one of the main air transport companies serving the eastern and south-eastern regions of Ukraine. The airport is operated by the "Zaporizhzhia" International Airport Municipal Enterprise. The need to create a high-tech regional airport has been determined by the Zaporizhzhia City Administration, on the initiative of which a comprehensive modernization of the airport is underway. A key element of this modernization is the start of construction of a new European-style passenger terminal. The airport covers areas with a population of more than 4 million people, which is a basic market potential that will develop in the future [11]. Zaporizhzhia city and the surrounding areas remain an attractive destination for business, which demonstrates the growing demand for air transportation in the airport coverage area.

The unique geographical position of the Kyiv city at the crossroads of three Pan-European international transport corridors № 3, 5, 9, approved by the European Community Cretan Conference, the existing transport and logistics infrastructure create the necessary preconditions for increasing transit of goods and passengers in the "North-South" and "West-East" directions, motivate the conception of a multimodal transport and logistics clusters network with a key status of airports "Kyiv" named after I. Sikorsky (Zhulyany) and Boryspil (Kyiv).

"Kyiv" International Airport cooperates with 43 airlines, operating flights to approximately 140 cities in 48 countries. About 2,500 flights are made monthly, and

almost 2 million passengers are served annually. The most popular international destinations since the beginning of 2020 are Minsk (Belarus), Warsaw (Poland), Vienna (Austria), Berlin (Germany), Memmingen (Germany), Tallinn (Estonia), Frankfurt am Main (Germany). The most popular domestic destinations since the beginning of 2020 are Zaporizhzhia, Odesa, Lviv.

"Boryspil" International Airport is the largest and most powerful in Ukraine. It provides about 65% of Ukraine's air passenger traffic, and annually serves more than 8 million passengers.

"Boryspil" Airport is successfully located at the crossroads of many air routes connecting Asia with Europe and America. About 50 national and foreign airlines carry passengers and cargo from "Boryspil" on more than 100 regular routes.

The airport has two runways and three passenger terminals. The technical capabilities of "Boryspil" Airport aerodrome remain unique for Ukraine, the CIS countries and Eastern Europe. The runway with a length of 4000 m and a width of 60 m allows you to receive aircraft of all types around the clock, including in conditions of limited visibility. "Boryspil" is also the only airport in Ukraine from which transcontinental flights are operated [13].

The activity of the largest international airport in Ukraine "Boryspil" testifies to its sustainable development and modernization. The airport management plans to reconstruct the airport infrastructure, build a new cargo terminal and all this together creates favorable conditions for the organization of a transport and logistics cluster based on the airport.

The network of aviation transport and logistics clusters has the opportunity to develop multimodal transportation, provide high-speed land transport by various modes of public transport between airports and settlements, create logistics centers and simplify formalities, reduce the negative impact of vehicles on the environment through the introduction of new technologies

and with priorities defined by the standards and recommended practices of the International Civil Aviation Organization (ICAO) and the requirements of Eurocontrol.

To create favorable conditions for the development of an effective competitive multimodal national transport system in Ukraine, it is necessary to use a comprehensive approach to the reconstruction of airports. Taking into account the requirements of European regulations on the certification of civil aerodromes for the unrestricted acceptance of aircraft by airports, there is a need for reconstruction with the provision of category I or II instrument landing system (ILS) and 7th category of fire protection with appropriate equipment and ground equipment.

Since air transport is characterized by a global trend – the growing role of cheap "low-cost" air transportation for direct interregional connections, it is advisable to involve other airfields and airports in the network of air transport and logistics clusters for "low-cost" passenger traffic. This will significantly increase their investment attractiveness for international commercial lending.

In a multimodal transport and logistics cluster, taking into account international experience, it is possible to introduce a "single transport ticket" for intermodal passenger transport as well as to transport goods under one contract with the optimal choice of transport for air, rail and other modes of transport. This requires the adaptation of national legislation to the norms and standards of the EU, as well as countries that are members of international associations. The carrier-operator (cluster coordinator) is responsible for the entire transportation route, optimizes the processes of interaction in coordination with other participants providing a particular service, as well as rationally coordinates the provision of transport accessibility for the population, high mobility of labor, increasing distance and reducing the travel time of passengers in megacities [6].

In terms of air freight in the aviation transport and logistics cluster system, it is expedient to take into account additional opportunities from the combination of aviation with the sea, road and rail within the New Silk Road between China and Europe via Ukraine, introduction of electronic document management at airports using the experience of Ukraine and recommendations of the International Port Community Systems Association (IPCSA) [6].

Increasing the volume of export-import traffic between Europe and the countries of South Asia and the Middle East, first of all, with China and India will contribute to the creation of an integrated into the world transport network safely functioning and efficient transport complex of Ukraine on the way of the main transit flows, as well as the prospects of expanding Ukraine's foreign trade relations with these countries and the European Union.

The development of the transport complex is becoming one of the key issues in supporting the sustainable development of Ukraine and its achievement of a regional transport hub with the integration of transport technologies and regional mobility projects in the form of transport and logistics clusters with the coordination mission of leading airports.

Effective management of the aviation transport and logistics clusters network is based on the principles of formation and coordination of management different types of transport: voluntary partnership, innovation, transparency and stability of "rules of the game", multimodality, satellite navigation, intelligent transport systems, information technology, electronic document management and corporate social responsibility. These principles ensure the creation of equal conditions for the provision of transport services, prompt receipt of key performance indicators, accumulation, systematization, processing, analysis and interpretation of data, provision of timely information and its effective use by transport and logistics cluster members to make business decisions based on facts.

Today it is necessary to implement these principles in the transport sector as conceptual "rules of the game" in the development of aviation transport and logistics clusters, which provide for integration with scientific, educational institutions, chambers of commerce and industry of Ukraine and relevant executive bodies. It is important to have a sound state policy to support the consolidation of aviation transport and logistics clusters in the country's top management structure: the Cabinet of Ministers of Ukraine – Ministry of Infrastructure of Ukraine – Supervisory Boards, the Board of various modes of transport on the basis of relevant legislation.

The competitiveness of the aviation transport and logistics clusters network in the global environment is influenced by the implementation of transport safety measures in order to create an effective transport safety management system. Achieving the target level of air traffic management performance at the level of aviation transport and logistics cluster requires the appropriate development of communication, navigation and surveillance (CNS) infrastructure in accordance with the European Master Plan for Air Traffic Management (ATM) [14]. The target level of ATM productivity for Europe is achieved at local level and will also depend on local conditions. Significant productivity growth can be achieved in Europe in several key areas, namely, environmental protection, capacity, cost-effectiveness, operational efficiency, and security and safety. These areas will be crucial for the subjects of the aviation transport and logistics cluster. Why is the Master Plan important for global engagement? Because aviation is a global industry and synergies with global management coherence are key components for its safe and sustainable growth. The EU-US Memorandum of Cooperation (MoC) provides the basis for a coordinated approach by SESAR and the US Federal Aviation Administration's NextGen project, namely, under the joint coordination of the

International Civil Aviation Organization (ICAO).

The SESAR-supported target level of productivity is quite impressive and is linked to the productive capacity that will be achieved if SESAR solutions are implemented through timely and, if necessary, synchronized and fully synchronized research. An important component in this direction is the creation of aviation clusters and technology parks for aviation in higher education institutions. In the Kropyvnytskyi city on the basis of the Flight Academy of the National Aviation University it is planned to implement an investment project of the Flight City Technopark in the following areas: unmanned aerial vehicles, small aircraft, simulators based on artificial intelligence, virtual and augmented reality [15].

The globalization of transcontinental air transportation in the framework of powerful global alliances encourages the creation of an integrated into the world transport network safely functioning and efficient network of aviation transport and logistics clusters to ensure the competitiveness and efficiency of the Ukraine transport complex. Further use of the key status of transport intermediary by Boryspil International Airport as a leading international hub airport of Eastern Europe in creating an aviation transport and logistics cluster involves expanding the network of air connections, building a modern transit infrastructure, applying a flexible approach to attracting business models and increase in revenues from non-aviation activities.

Since the leading Boryspil airports and others carry out inter-organizational coordination of cluster entities on the basis of mutual trust, they should also promote: the development of modern terminal passenger and cargo complexes (multimodal logistics centers) at airports through their owners and mechanisms of state private partnership with ICAO standards; streamlining of legal and operational relations between balance

holders and actual operators of aerodromes regarding their maintenance, operation, repairs, etc.

Conclusions. Today, the strategic priority of Ukraine's development is active European integration, which is accompanied by the effective development of the national economy, acceleration of production digitalization, change of supply chains, and coordination of various modes of transport. The key source of improving the level of economic development of Ukraine, reducing the gap with developed countries is to stimulate Ukrainian exports and the development of domestic production and trade to improve the efficiency and quality of transport services.

Ukraine's active integration into the European Union requires an appropriate transport and logistics infrastructure of clusters, services for participants. Aviation transport and logistics clusters can be developed together with the world [16] on the European Cluster Collaboration Platform. This platform is the main tool for information and cluster collaboration in the EU. It contains a lot of information about the existing clusters in the EU (as well as associated countries, including Ukraine), events and tools of the platform and partners, current initiatives and projects.

The formation of the aviation transport and logistics clusters network as drivers and catalysts for economic development in the regions will allow maximizing the transport potential of Ukraine. This will make it possible to create a customer-oriented system of transport services and obtain a synergy effect from the optimal coordination of the leading airports of the potential of all transport modes on the basis of partner-competitive principles during transportation.

References

1. National Transport Strategy of Ukraine for the period up to 2030: Order of the Cabinet of Ministers of Ukraine of May 30, 2018 № 430-r / Prime Minister of Ukraine. URL: <https://zakon.rada.gov.ua/laws/show/430-2018-%D1%80#Text> (access date: 14.07.2020).
2. Gritsenko S.I. Paradigm of innovative development of the Ukraine economy in the context of transport and logistics clusters: monograph Innovative development of the economy: global trends and national features. – Collective monograph. – Lithuania: Publishing House «Baltija Publishing», 2018. – 716 p. (P. 114-128).
3. Porter M.E. Competition. Moscow, 2005. – 608 p.
4. Clusters in the economy of Ukraine: a monograph / edited by M.P. Voinarenko. – Khmelnytsky: KhNU, FOP Melnyk A. A., 2014. – 1085 p.
5. Sokolenko S.I. Clusters in the global economy. Kiev, 2004. – 848 p.
6. On approval of the Aviation Transport Strategy of Ukraine for the period up to 2030: Draft order of the Cabinet of Ministers of Ukraine / Prime Minister of Ukraine. URL: <https://mtu.gov.ua/projects/view.php?P=223> (access date: 14.07.2020).
7. "Lviv" International Airport named after Danylo Halytskyi. URL: https://lwo.aero/uk/general_info (access date: 14.07.2020).
8. "Dnipro" International Airport. URL: <https://kiyavia.com/aeroporty/dnipro#blok3> (access date: 14.07.2020).
9. "Odesa" International Airport. URL: <https://odesa.aero/page/o-nas> (access date: 14.07.2020).
10. "Kharkiv" International Airport. URL: <https://kiyavia.com/aeroporty/harkiv#blok3> (access date: 14.07.2020).
11. "Zaporizhzhia" International Airport. URL: <https://ozh.aero/about-us/> (access date: 14.07.2020).
12. Statistics of "Kyiv" International Airport. URL: <https://iev.aero/press-centre/stats> (access date: 14.07.2020).
13. "Boryspil" International Airport. URL: <https://ua.grundfos.com/cases/find-case/Borispil.html> (access date: 14.07.2020).
14. European ATM Master Plan. 2015. URL: file:///C:/Users/1/Downloads/European_ATM_Master_Plan_Executive_Summary_RU.pdf (access date: 14.07.2020).
15. "Flight City" Technopark to be built in Kropyvnytskyi for \$ 250 million. 2020. URL: <https://mandarin-news.kr.ua/suspilstvo/u-kropyvnytskomu-za-250-milioniv-dolariv-maiut-zbuduvaty-tekhnopark-flight-city> (access date: 14.07.2020).
16. Clusters – as drivers of development and counteraction to crisis phenomena. Digest №5. 2020. URL: <https://www.industry4ukraine.net/digest-5/> (access date: 14.07.2020).

UDC 656.062:658.7:658:81
JEL Classification: F 42, F 53, H56, P41, P47.
Received: 24 July 2020

DOI: <https://doi.org/10.46783/smart-scm/2020-2-2>

Kostiuchenko L.V. PhD of Economics, Associate Professor, Associate Professor of Logistics
Department National Aviation University (Ukraine)

ORCID – 0000-0002-7635-5153

Researcher ID – S-7795-2018

Scopus author id:

Kostiuchenko A.V. lieutenant-colonel Armed Forces of Ukraine, Kyiv, Ukraine (Ukraine)

ORCID – 0000-0002-5585-3831

Researcher ID –

Scopus author id:

THE LOGISTICAL SUPPORT SYSTEM ELEMENTS FOR THE PREPAREDNESS FOR MILITARY OPERATIONS

Lesia Kostiuchenko, Andrii Kostiuchenko. *«The logistical support system elements for the preparedness for military operations».* The modern views of the essence and content of logistics support for the preparedness for military operations for military logisticians and academic experts differ in some way. The main differences in the views of the authors are based on defining the boundaries of the logistics system. In particular, military traditions significantly narrow the field of logistics management of the processes of providing structural units under certain conditions. At the same time, approaches to the organization of logistical support of rear structures and units that perform military operations are different algorithms. On the contrary, according to the academic vision, the logistics of military units is only part of the macro-logistics system. That is why the purpose of this study is to search a science-based system of supporting of all participants in the logistics chain for the preparedness for military operations.

The implementation project of key elements of the logistical support system of readiness of the armed forces units for military operations is offered. The implementation of these proposals is expected to achieve a synergistic effect, namely: a powerful reduction in time, which is very critical in terms of active military operations; achieving high quality of logistic support operations; reducing the prime cost of operations, especially one-time or functionally unacceptable for military units; quick reaction to change of conditions, etc. Such results can accelerate the practical implementation of NATO standards in the armed forces.

Keywords: logistics support, logistics system, support of military units, outsourcing of logistics operations, resource potential of military logistics.

Леся Костюченко, Андрій Костюченко. *«Елементи системи логістичного забезпечення готовності до військових операцій».* Сучасне бачення військових логістів та академічних експертів змісту логістичного забезпечення готовності до військових дій ґрунтуються на визначенні меж логістичної системи. Зокрема, військові традиції значно звужують сферу управління логістикою процесів забезпечення структурних підрозділів за певних умов. У той же час, підходи до

організації матеріально-технічного забезпечення тилових структур і підрозділів, які виконують військові дії є різними алгоритмами. Навпаки, відповідно до академічного бачення, логістичне забезпечення військових підрозділів є лише частиною макрологістичної системи. Саме тому метою цього дослідження є пошук науково обґрунтованої системи підтримки всіх учасників логістичного ланцюга щодо готовності до військових операцій.

Запропоновано проект впровадження ключових елементів системи логістичного забезпечення готовності підрозділів збройних сил до військових операцій. Результатом реалізації наведених пропозицій очікується досягнення синергічного ефекту, а саме: потужне скорочення витрат часу, що є дуже критичним за умов ведення активних військових операцій; досягнення високої якості операцій логістичного забезпечення; зниження собівартості операцій, особливо разових або функціонально-неприйнятних для військових підрозділів; швидка реакція на зміни умов тощо. Такі результати можуть прискорити практичну реалізацію стандартів НАТО у збройних силах.

Ключові слова: логістичне забезпечення, логістична система, забезпечення військових підрозділів, аутсорсинг операцій логістичного забезпечення, ресурсний потенціал військової логістики.

Леся Костюченко, Андрей Костюченко. «Элементы системы логистического обеспечения готовности к военным операциям». Видение военных логистов и академических экспертов на сущность логистического обеспечения готовности к военным операциям основываются на определении границ логистической системы. В частности, военные традиции существенно сужают сферу управления процессами обеспечения структурных подразделений в конкретных условиях. При этом подходы к организации материально-технического обеспечения тыловых структур и подразделений, выполняющих военные операции, являются разными алгоритмами. И, наоборот, в соответствии с академическим видением, логистическое обеспечение военных подразделений является лишь частью макрологистической системы. Поэтому, целью данного исследования является поиск научно-обоснованной системы поддержки всех участников логистической цепочки касательно их готовности к военным операциям.

Предложен проект внедрения ключевых элементов системы логистического обеспечения готовности подразделений вооруженных сил к военным операциям. Результатом реализации приведенных предложений ожидается достижение синергетического эффекта, в частности: мощное сокращение затрат времени, что является критичным в условиях ведения активных операций, достижение высокого качества операций логистического обеспечения; сокращение себестоимости операций, особенно разовых или функционально-неприемлемых для военных подразделений; быстрая реакция на изменения и пр.

Ключові слова: логистическое обеспечение, логистическая система, обеспечение военных подразделений, ресурсный потенциал военной логистики.

Introduction. Modern military-political Ukrainian realities require the formation of a single effective logistic support system of military units. The main strategic goals of our country must correlate with NATO logistics standards and instructions. So it's very important to search a science-based system of supporting of all participants in the logistics chain for the preparedness for military operations.

Analysis of recent researches and publications. Modern scientific publications contain a large amount of material devoted to the logistic support of different activities. The

article [4] explained the content of the term "logistics of the defense sector". This topic has also gained popularity in the military sphere. In particular, in June 2020 took place Scientific and practical webinar on the topic "Improving the logistics of the Armed Forces of Ukraine based on the experience of the joint forces operation" in the National University of Defense of Ukraine named after I. Chernyakhovsky. Most of the reports were based on the principles of the NATO logistics experience.

There is interpretation of the terms "logistic support", "material and technical

support", "logistics management bodies", "forces and means of logistics" in the Resolution of the Cabinet of Ministers [10].

So, logistic support is a complex of "measures from: logistic support planning; identification of armaments needs, special and vehicles, combat (military and special) equipment, material and technical means and services; design, development (modernization and modification) of armaments, military and special equipment and logistical means, their purchase, supply, storage, repair, maintenance, operation control; sale, write-off and utilization of surplus weapons, military and special equipment and material and technical means; planning and implementation of military transportation by all modes of transport; purchase of works and services of bath and laundry, trade and household services; catering; quartering of troops (forces, bodies); procurement or construction, maintenance, operation of military infrastructure" [10].

The material and technical means include: "missiles, ammunition, military equipment, fuel, special liquids, food, belongings, medical and other property, in addition to real estate, which are necessary to ensure the components of the defense forces in the performance of their defense tasks, protection of its sovereignty, territorial integrity and inviolability" [10].

Logistics support bodies are "military management bodies (management bodies) of the Armed Forces, other military formations, of the law enforcement and intelligence agencies, the State Special Communications, the State Emergency Service, which are authorized by law to provide tasks for logistic support". [10]

The forces and means of logistic support are: "arsenals, bases, support centers, warehouses, automobile and repair and restoration military units (subdivisions) of the Armed Forces, other components of the defense forces, which are designed to maintain stockpiles of weapons, military and

special equipment, material and technical means, their transportation, maintenance and repair"[10].

In particular in the NATO Logistics Handbook (1997) we read "the definition of logistics by NATO covers a wide range of responsibilities that fall into different areas of the NATO organization" [8]. NATO logistics is largely identified with the concept of logistic supporting. So NATO Logistics Handbook offers the two aspects of logistics have to do with the relationship between the producer and the consumer, and two additional aspects that have to do with how logistics functions are performed [8]:

- Cooperative Logistics is the totality of bilateral and multilateral consumer and production logistics arrangements to optimize in a coordinated and rationalized way, logistics support to NATO forces. The aim of NATO Cooperative Logistics is to achieve cost savings through economy of scale and increased efficiency in peacetime, crisis and wartime logistics support. Development of NATO Cooperative Logistics arrangements is largely facilitated by the use of NATO Production and Logistics Organizations (NPLOs), particularly the NATO Maintenance and Supply Agency (NAMSA) using modern techniques in the field of materiel management and procurement.

Multinational Logistics must function as an effective force multiplier. With the risk now omni-directional, the diminishing logistic support resources, and the principle of shared logistics responsibilities, the evolution toward multinational logistics becomes of utmost importance. It is proposed that this term cover: "The different means to logistically support operations other than purely national, such as multinational integrated logistic support, role specialization support and lead nation support" [8]. There is classes by NATO of supply are established in the five-class system of identification as follows in the Table 1:

Table 1.

Classes of supply by NATO standards	
Class	Definition
Class I.	Items of subsistence, e.g. food and forage, which are consumed by personnel or animals at an approximately uniform rate, irrespective of local changes in combat or terrain conditions.
Class II.	Supplies for which allowances are established by tables of organization and equipment, e.g. clothing, weapons, tools, spare parts, vehicles
Class III.	Petroleum, oil and lubricants (POL) for all purposes, except for operating aircraft or for use in weapons such as flamethrowers, e.g. gasoline, fuel oil, greases, coal and coke.
Class III a	Aviation fuel and lubricants
Class IV.	Supplies for which initial issue allowances are not prescribed by approved issue tables. Normally includes fortification and construction materials, as well as additional quantities of items identical to those authorized for initial issue (Class II) such as additional vehicles.
Class V.	Ammunition, explosives and chemical agents of all types

Source: [8]

Thus, according to NATO logistics as logistics supporting is in fact material and technical supporting for the defense sector. The same interpretation and content of logistics is followed by Ukrainian military logisticians.

The basic principles on which the logistical support of the defense forces is based during their preparation and application are [10]:

- centralization of management to achieve effective implementation of tasks to meet the common needs of the components of the defense forces with the involvement of all available forces and means of logistical support of the defense forces components, taking into account their capabilities, as well as the efficient use of available resources;
- priority and sufficiency of logistical support for continuous and full satisfaction of the needs of the defense forces components in armaments, military and special equipment, material and technical means, as well as directing the main efforts of logistic support by the priority tasks performed by the defense forces during their preparation and the application;
- joint implementation of tasks to meet the needs of the defense forces by the joint efforts of central executive bodies, other state bodies, forces and means of which are

involved in the defense forces, the Armed Forces, other defense forces, taking into account their capabilities;

- interaction and coordination of actions between of the defense forces components and central (local) executive bodies, local governments, other state bodies, enterprises of the defense industry, other enterprises, institutions and organizations, regardless of ownership, on the provision of weapons, military and special equipment, material and technical means and services during the training of defense forces and during their application;

- functional compatibility of organizational structures of management bodies of logistical support of defense forces components and the forces and means subordinated to them;

- cooperation of the constituent forces of the defense with the bodies of foreign states, international organizations and the armed forces of other states in matters of providing the constituent forces of the defense with material means and services during their preparation and application in accordance with the powers defined by law.

The speakers of Scientific and practical webinar [11] somewhat clarified the above principles of logistical support of the rear and troops in operations. Emphasis was placed on

the efficiency of the use of the received military property / services and infrastructure facilities, the flexibility of processes and the stability of logistical support as well as of the possibility of integrating the logistics system of the Armed Forces of Ukraine or its individual elements during joint operations with the armed forces of NATO member states. The last thesis brings logistical support to the macro level.

Military logisticians define the ultimate goal of logistics as the acquisition by the Armed Forces of Ukraine of such qualities that will ensure the ability in peacetime to ensure the combat and mobilization readiness of forces in their new form. And in wartime, the ultimate goal of logistics is to increase their combat capabilities at all levels of armed struggle: strategic, operational, and tactical. So the essence of improving the provision by military property to forces services of in peacetime with the introduction of logistics in the Armed Forces of Ukraine is the need of [11]:

- reviewing the functions of the elements of the military property supply system and the system as a whole;
- identifying the priority, sufficiency and redundancy or duplication of supplies;
- transition to new organizational and staffing structures, to build a vertical of their management, a system of staffing and training of services included in the logistics system;
- development of modern approaches to the accumulation, structure and use of military stockpiles, organization of military transportation and evacuation, technical equipment (military units and subdivisions, institutions and medical establishments);
- improvement of economic activity, quality of planning, efficiency of infrastructure operation;
- optimization of costs for the purchase and provision of services, etc.

In the context of European integration and new tasks of the Armed Forces of Ukraine related to Ukraine's participation in environmental protection, anti-terrorist

operation, peacekeeping activities under the auspices of NATO and the UN, webinar participants [11] stressed the need to reform troops (forces), types of logistics, technical and medical support in accordance with NATO standards.

In this context, the organization of logistics management is to create an appropriate management system, maintaining any level of its readiness, building and ensuring the smooth carrying operations (combat operations). In addition, they formulated the main transformation directions of the existing system of military property and services of the Ukrainian Armed Forces, such as: complete change of all rules and procedures of procurement, introduction of electronic procurement and electronic document flow. This, according to military logisticians, will contribute to the creation of an effective logistics system of the Ukrainian Armed Forces, capable of planning and managing the processes of logistics of troops (forces) both in peacetime and in special periods and will be compatible with the NATO system.

The generalized modern vision of the Armed Forces of Ukraine on the formation of the logistics system is published in [13]:

- "Logistics forces will continue to develop in order to maintain armaments and military equipment, material resources and provide them to troops (forces), all components of the defense forces, as well as to create an effective system of infrastructure for troops (forces), which will ensure guaranteed performance of such basic tasks: real estate management, ensuring their settlement in permanent locations and during the performance of tasks in operations, maintenance of facilities and means of infrastructure, energy and utilities.

- Determining the needs and planning of logistic support will be entrusted to the logistics units (J, G, A, N, S-4) of the General Staff of the Armed Forces of Ukraine, commands of species, certain types of troops (forces), operational (air) commands and military units.

- The organization of logistical and infrastructure support will be entrusted to the Logistics Forces Command.

- In the medium and long term, units and subdivisions of logistical support will be consolidated into joint logistic support centers".

It's difficult to disagree with the fact that the logistics management system must have a high combat readiness, survivability, resilience and provide the possibility of both centralized and decentralized management. So, the system of troops management automation is a set of the means of automation of management united by a uniform information space which provide support of decision-making, their delivery to executors and implementation of control over their execution. Ultimately, the troops management automation system has to ensure that such operations are performed [11]:

- collection, processing, analysis and evaluation of data on the location, condition, composition and stocks of material means of troops;

- reception, processing and display of commands and signals of combat control "from top to bottom" – from the highest body of military management;

- formation and issuance of confirmations of received signals and commands, exchange of formalized and informal information;

- management of troops in different states (in the course of daily activities, during the transition from peacetime to wartime and in wartime when solving operational tasks);

- automation of planning and management processes of the regular forces and means;

- information protection and cyber security;

- integration of existing automation systems and tools.

The skills of synchronization of each combat operations function with the general picture of operation in units of armed forces train during preparation, carrying out

rehearsals of logistics within the limits of one or limited number of combat tasks. Such support rehearsals allow commanders to see the big picture and make decisions in real time. Their goal is to harmonize logistics with maneuvering plans, not to respond to changes in combat. One of the webinar speakers [11] also noted that even when units adhere very closely to the concept of supply, the changes could place excessive numbers of troops and armaments in the way of movement and thus cause damage due to a lack of prior planning with support units. In practice, however, supplies often do not provide adequate combat support as a result of brigade support, an advanced support company (FSC) and a supported maneuvering battalion. In general, the support rehearsal creates future decisions and causes changes in logistics requirements and solves the question of: who, what, when, where and how.

Thus, based on the results of the support rehearsal, the units have to answer the following questions [11]: What is the current status of logistics in each echelon? What are the problems with combat power that affects units? What are the ongoing supply arrangements in the echelon supervision units? What is the priority of support? What is the priority of the service and does it support the main efforts? What is the priority of supply? What is the priority of the care operation relative to weapons, medical assets etc.? When will the units need to be replenished and what are the signs for replenishment? What is the action plan for mass losses?

Military experts are convinced that without proper logistics planning and synchronization for all teams, the battle will be lost. With which we completely agree too. Therefore, each unit has to integrate the rehearsal of the support according to its own timeline of continuous training, as well as the decision-making process and define standard operating procedures. [9, 11].

However, taking into account the current unstable military-political situation in

Ukraine, it's appropriate to take into account the academic understanding and vision of the formation of a logistical support system for military operations readiness. First of all, it is worth paying attention to two key principles of logistics management – system-process and variable-situational principles, which are described in detail in [6, pp. 56–66].

In the monograph [3, pp. 185–189] a distinctive feature of the logistics economy is the focus on market segments, territories, regions and the country as a whole, not only it, but not only on enterprises, which reflects only the corporate goals of logistics services. The concept of economic space of logistics is revealed, which correlates with the concept of logistics system, the objects of which are enterprises of different branches of economy, logistics capacities, transport communications, telecommunication systems, etc., These objects interact in accordance with the spatial (territorial) structure of the economy and the spatial (territorial) organization of economic entities, united by material and accompanying flows. Thus, according to Professor Grigorak M.Yu., it's important to study first the economic relations that arise in the economic space of logistics [3, pp. 185–189], and then work on the coordination of logistics flows.

"In the theoretical and cognitive aspect of the logistics system" the Professor Alkema V.H. writes in his own monograph [2] "it's a subsystem of the economic system. Its feature at the macro level as an object of management is a set of interconnected and interacting logistics entities that develop the total resource potential, organized in the form of logistics flows by optimizing and streamlining them". [2, p. 83].

This understanding of the logistics system as an economic space suggests that logistics is an element of the entity potential, namely its resource component. According to Professor Alkema V.G., the definition of the term "potential" is more widely used in relation to a particular type of resources or their combination, and two "resource" positions are distinguished [1]:

1) potential as a set of resources without taking into account their relationships and participation in the production process is a generalized, collective characteristic of resources (quantity and quality of resources that a system has);

2) as a set of resources capable of producing a certain amount of material goods, as it characterizes the resources of production, their quantitative and qualitative parameters, which determine the maximum capacity of society to produce material goods at any given time. That is, it's a reflection of the ability to achieve high end results through the most efficient use of available resources. After all, the concept of "resource" belongs to the elements of the operational process and is, in essence, opportunities to achieve goals that are determined by potential. Professor Alkema V.G. identifies two alternative scientist's views on the concept of resource potential [1]:

First, as a set of all resources of the enterprise, providing the opportunity to obtain the maximum economic effect at a given time;

Secondly, as a system of resources, an interconnected set of material, energy, information tools, as well as the themselves workers, who use (or can use) them in the production of material goods and services.

The resource approach to the separation of logistics systems means that economic entities operate in conditions of limited resources and interact with each other in accordance with economic laws in order to [3]: maximize the results of their activities (with a given amount of production resources to strive for maximum output); minimize the cost of production resources under a certain volume of production; optimize results (costs and results have to be in a certain optimal combination).

The functioning of organizations – participants in the economic system of the highest order can't do without interaction with other organizations, components of market infrastructure. In particular, "economic and organizational relations of

enterprises-producers of goods and services make it possible to carry out exchange processes and bring the manufactured products to the final consumer. Therefore, ... today it is not the availability of own resources in the enterprise that comes to the fore, but the opportunity and ability to use available external resources within the framework of mutually beneficial cooperation of companies in the supply chain". [3, p. 186]. According to the author [3], the resource concept of the logistics system formation involves the spatial component of the logistics system resources and the decomposition of their elements (on types and subtypes of resources by links of the logistics system). Logistics system resources include [3]: tangible assets (fixed assets, current assets, investments) – transaction costs; human resources (qualification, skills, activity / effectiveness) – partnership; intangible assets (strategic assets, own technologies, reputational assets, goodwill) – achieving a synergistic effect.

The purpose and objectives of the study. The analysis of publications of the above authors shows, that the views of the essence and content of logistics support for the preparedness for military operations for military logisticians and academic experts differ in some way. The main differences in the views of the authors are based on defining the boundaries of the logistics system. In particular, military traditions significantly narrow the field of logistics management of the processes of providing structural units under certain conditions. At the same time, approaches to the organization of logistical support of rear structures and units that perform military operations are different algorithms. In contrast, the academic vision of the logistics support of military units is only part of the macro-logistics system. That is why the purpose of this study is to search a science-based system of supporting of all participants in the logistics chain for the preparedness for military operations.

Basic material and results. Given the resource concept set out in the monograph [3], we can agree with the author that in the

theoretical and methodological sense the most developed concept for the formation of the national logistics system should be considered the concept of synergy and system dynamics, which are combined in an economic theory system. Depending on the features of spatio-temporal localization among economic systems, there are four basic groups [3, p. 187]: a) environmental type systems for which spatial and temporal boundaries are not defined (socio-economic institutions, business climate, infrastructure, Internet, etc.); b) process-type systems for which temporal but not known spatial boundaries are known (logistic processes, dissemination of innovations, knowledge transfer); c) system-type systems for which both temporal and spatial boundaries are defined (construction of logistics centers, production development of a new type of product, holding mass events); d) object type systems for which spatial but not temporal boundaries are defined (country, region, enterprise, etc.).

For example, based on the principles of NATO Logistics and the content of the resource concept, Cooperative Logistics is an environmental type system, because it's the combination of bilateral and multilateral consumer and production logistics arrangements. It should be added that such a combination makes it possible to achieve a synergistic effect. And Multinational Logistics is an object type system because it covers the different participants and means to logistically support operations. So, "clear spatial and temporal determination of subsystems makes it possible to determine the nature of their interaction and "natural" properties: each of the subsystems is not a priori self-sufficient, doesn't have all the features and properties necessary to maintain its own homeostasis and therefore can't be stable in the long run... However, by interacting ... all four systems together support each other's homeostasis and the stability of the system as a whole" [3, p. 188]. Such interaction, in fact, causes synergy.

Effective implementation of the resource concept is impossible without a thoroughly planned process approach. The process approach to the management of logistics flows dictates the need to apply the methodology of business process reengineering, taking into account the specifics of logistics. The combination of work procedures and operations into one is characterized by the absence of "assembly line" technology, in which simple tasks or work procedures are performed at each workplace. In the process approach to logistics flow management, procedures previously performed by different employees are integrated, resulting in horizontal process compression. According to experts, this compression accelerates the execution of processes by about 10 times [6]. In contrast to horizontal compression as a consequence of the process approach, independent decision-making by the executor provides vertical compression of processes and eliminates the need to spend time to apply to the top management structure.

According to Professor Kulik V.A. resourcefulness is one of the main properties of the logistics flow, along with such as: territorial location, target orientation, elemental structuring, process coherence, system organization, legal allocation, multi-flow [6]. Disclosure of the essence and variety of properties of the logistics flow allowed identifying the substantial heterogeneity of the composition and multi-vector motion of individual elements of the logistics flow as an object of management in compliance with the established subordination of processes caused by its multi-flow [6].

It's difficult to disagree with the fact that the revolutionary transformations in the basic issues of military affairs have led to significant changes in the conditions of logistical support of forces with military property and services. There was a multiple increase in the volume of tasks to provide forces. Due to the further development of armaments and military equipment, the emergence of high-precision weapons, weapons on new physical

principles, as well as changes in the methods of preparation and conduct of operations, the conditions for providing forces with military property and services have become sharply more complicated and increased. [11]. Therefore, the logistical support system for the preparedness for military operations in accordance with the purpose, has to be able to coordinate resources, equipment, information and people quickly, accurately, coordinated in conditions of constant instability and changes in time parameters. In order to achieve this feature of the logistics system, military logisticians propose to integrate NATO Logistics projects by creating a new structure for procurement, joining support and supply services. The result of such integration, in their opinion, will be achieved [9, 10, 11]:

- improving the quality of military property, the responsibility of suppliers for product quality and trust in them and creation of a state guarantee system of the defense products quality;
- improving the system of outsourcing services, following the example of NATO member countries, where food services are provided by a structural unit of the Ministry of Defense, which is obliged to provide these services both in peacetime and in other cases;
- clarification of the division functions of providing military property to the Armed Forces between the Ministry of Defense and the General Staff;
- achieving compliance of the composition and capabilities of logistics management bodies, military units and institutions to the assigned tasks, taking into account the established number;
- improvement of methods of work and use of automated technical means, high technologies for the purpose of structure improvement and number of military management bodies, forces and providing means reduction;
- introduction of principles of conformity and mutual compatibility, structural management subdivisions and

forces of maintenance in peacetime and wartime.

Based on the experience of NATO Logistics, military logisticians propose to optimize the support system of the Armed Forces of Ukraine. To this goal, it's proposed to achieve the maximum degree of autonomy at all operation levels of this system and implement the following measures [9, 10, 11]:

- determination of the volume and order of separation of military property stocks taking into account the reduction of the combat and numerical composition of the Ukrainian Armed Forces, as well as their transition to a three-tier structure;
- reduction of redundant infrastructure, which doesn't directly affect the level of combat readiness of forces;
- improving organizational and economic forms of management, including by expanding the participation of the national economy civil sector in providing forces and modernization of technical equipment of logistics support classes (see above the Table 1);
- optimization of the training system of servicemen and civilian personnel in specialties belonging to the types of logistics and classes of military means.

It's worth noting the following feature of the approaches vision to the tasks of the logistical support system for the preparedness for military operations by military logisticians: separation of the logistic support for the rear zone from the zone of active combat operations. As a result, with such a vision, management decisions and approaches (requirements, tasks, principles, parameters) for the organization of support are also different. In our opinion, this fact explains the frequent failures or low-level quality of logistical support of certain facilities (subdivisions of the Armed Forces) in the conditions of changing parameters of supply (time, structure of logistics flows, suppliers, stakeholders, etc.) After all, the experience of conducting military operations in part of our country has shown that any changes in the zone of active hostilities require an immediate

response from the rear and therefore quick change. This explains the reasons for the sudden change in the parameters of supply in the process of delivery, disbandment, redeployment, and so on. As a result, response delays are very critical and sometimes fatal. Therefore, such a narrow approach to the planning of operations for the logistic support of military facilities needs to be some adjusted.

Here is one of the key properties of the logistics system – adaptability. Thus, the planning of logistics operations can be effective only if the flexibility and adaptability of the entire logistics system. It's necessary to apply the system-process principle, which "forms a system of logistics activities processes and is guided by them in the presence of branched connections: direct and inverse, formal and informal, internal and external, vertical and horizontal [6, p. 57]. Namely, the direction of the principle is oriented simultaneously in three directions: on the structure of the system (subsystems) in general; on the chains of flow processes; on a complex of logistic functions (Fig. 1).

This multi-vector direction of logistics system management contributes to a significant increase in its flexibility and adaptability. In other words, this step will allow a systematic approach to the effective organization of key processes of logistics, subject to a radical change in supply parameters. It's worth noting that the implementation of all logistics operations on one's own is often unprofitable. This is due to various reasons: narrow functional orientation of the Armed Forces units; their overload with the performance of basic functions; insufficient of technical or staffing support; lack (insufficiency) of the necessary logistics infrastructure; impossibility (limitation) of financing non-target operations; the long duration of obtaining permits for a sudden change in supply parameters – a late response to changes; low profitability (high prime cost) of logistics operations due to suboptimal planning for objective reasons, etc.

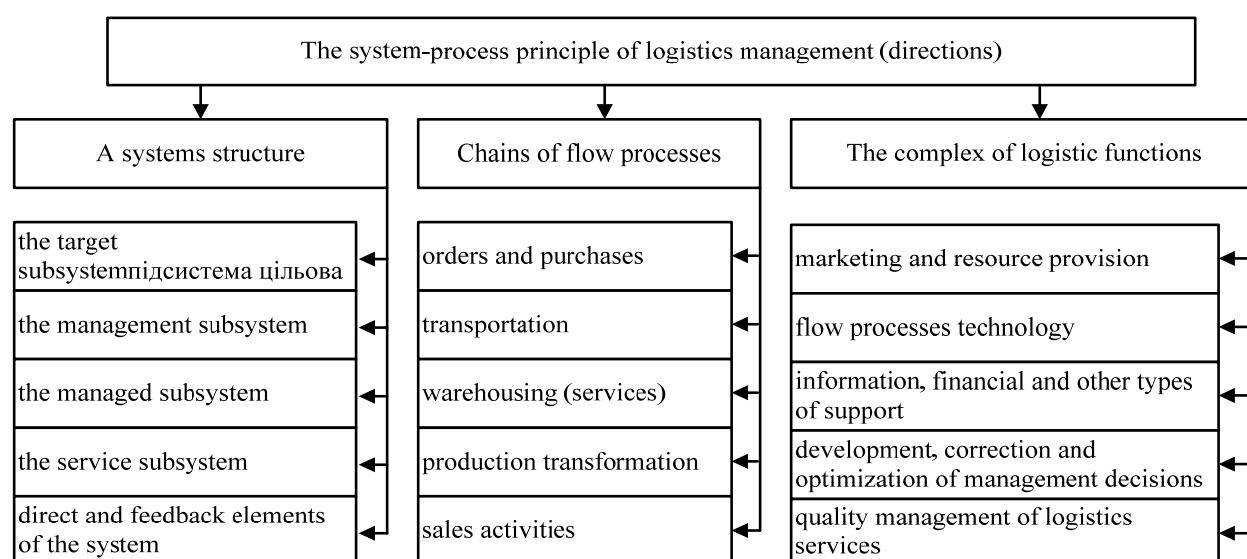


Fig. 1. The main provisions of the system-process principle of logistics management
 Source: [6, p. 57]

Of course, we are not talking about the supply of strategically important resources, manpower, information, etc. under the label "top secret". All operations that can be partially or fully to transfer to execution to the logistical provider should be outsourced. There is a fairly dense coverage of the routes of logistics transport companies, warehousing infrastructure, hubs, gas stations, service stations, medical infrastructure in the territory of Ukraine. In addition, there are a large number of

potential partners for the army in the food industry, light industry, IT-manufacturers, consulting companies to improve the skills of personnel involved in logistics, etc. Of course, choosing a list of potential partners of the army is no less a responsible task. There are developed, protocol-approved algorithms at all levels of the Armed Forces. We propose to use the following algorithm to determine the feasibility of transferring "permitted" logistics operations to outsourcing (Fig. 2) [5].

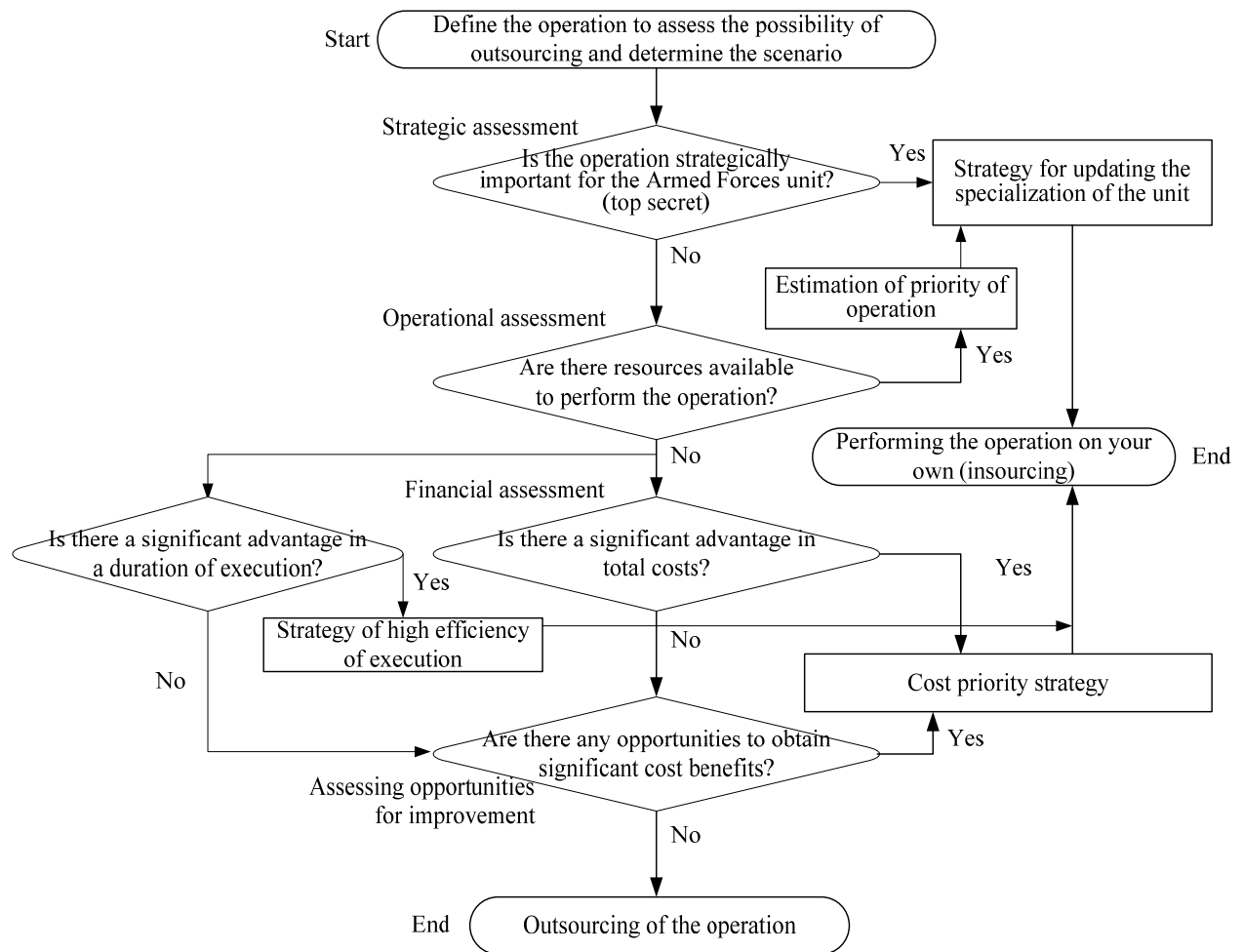


Fig. 2. Algorithm for determining the feasibility of outsourcing logistics operations.
 Source: developed by the author on the basis of [5]

The main factors that determine the feasibility of logistics outsourcing include: reducing the cost of work; reduction of time intervals for operations; service improvement; increase flexibility and achieve synergy effects; lack of knowledge and experience of

the company in the field of logistics; strategic considerations, etc. The priority is to create a procedure that provides a clear sequence of selection and evaluation of matrix criteria (Fig. 3) [5].

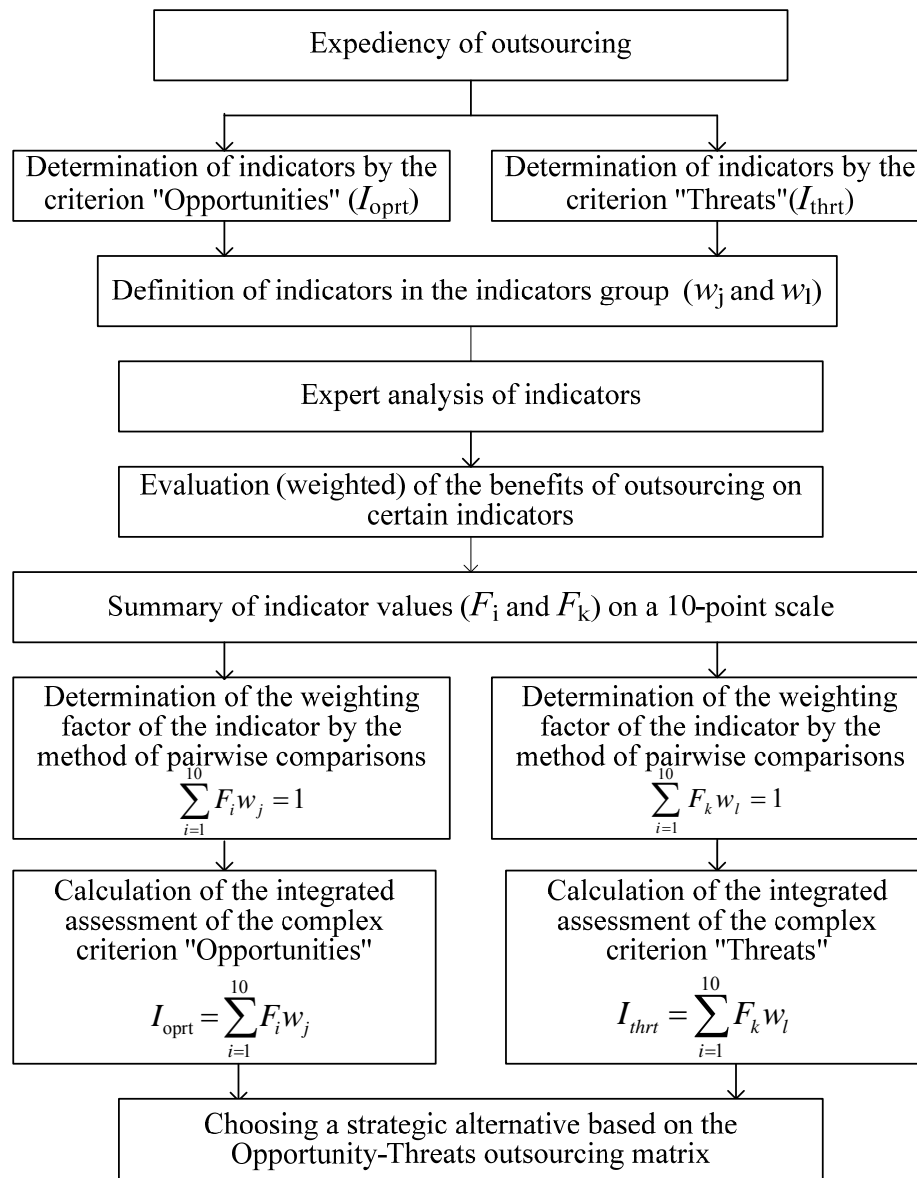


Fig. 3. The sequence of evaluation of the criteria for the transition to outsourcing for the outsourcing matrix "Threats – Opportunities"

Source: developed by the author on the basis of [7]

A generalized view of the "Outsourcing Matrix", which is filled with certain values of

the calculated integrated indicators, is given on the Figure 4 [7].

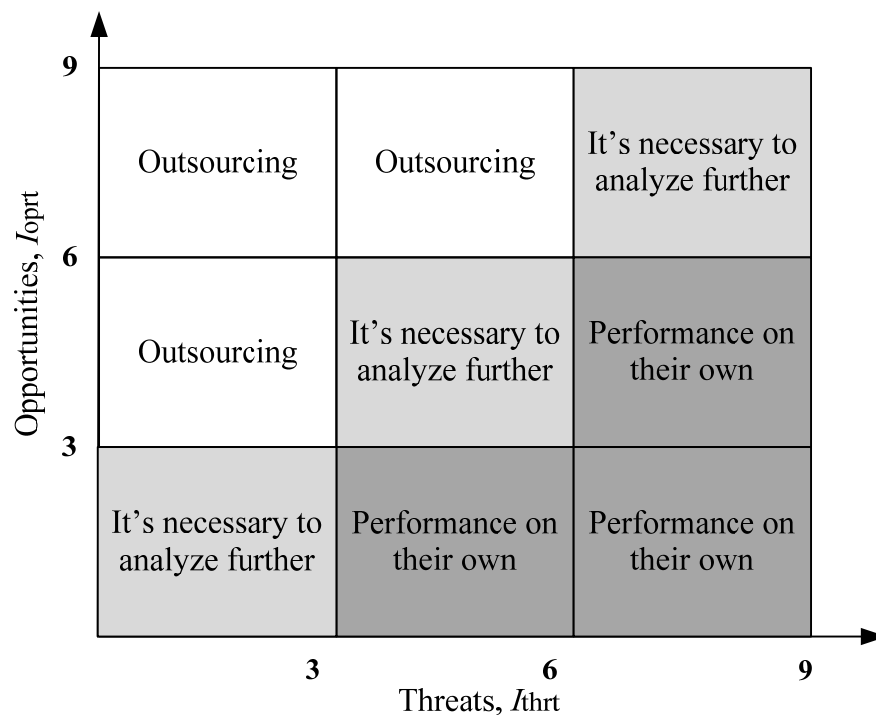


Fig. 4. Outsourcing matrix

Source: developed by the author on the basis of [7]

According to the above method, it is possible to make an informed decision on the feasibility of transferring a separate operation for logistics for the preparedness the Armed Forces for military operations and the selection of the optimal logistics provider or other strategic partner in the supply chain.

Conclusions. A science-analyzing of key elements supporting system of all participants in the logistics chain for the preparedness for military operations gives the following conclusions:

1) Traditional military delimitation of approaches to the implementation of the tasks of the logistical support system of the Armed Forces units for military operations, namely, the separation of the logistic support of the rear facilities from the zone of active combat operations, eliminates the possibility of achieving high efficiency, quality and profitability of tasks;

2) A high degree of bureaucracy in the army is superimposed on a low level of analytical assessment of the current situation in certain parts of the logistics chain, which as a result minimizes the practical

implementation of the principles and methods of NATO Logistics (NATO standards);

3) A practical experience shows that performing all logistics operations on their own is often unprofitable. There is a need for an internal audit of own resources, technical and infrastructural base, partly information infrastructure, etc. in order to identify the causes of low efficiency of logistics operations;

4) Under modern conditions there is an urgent need to develop an acceptable adapted algorithm for finding a reasonable solution for the feasibility of transferring a separate operation to ensure the readiness of the Armed Forces units for military operations and select the optimal logistics provider or other strategic partner in the supply chain.

5) it's worth considering (to make additional research) the total resource potential of military logistics and in particular the logistic support system of units from the standpoint of their readiness to change, optimize and streamline the management of logistics flows in conditions of high risk;

6) The military automation system developed by military specialists (it combines management automation tools into a single information space: decision support, bringing them to the executors, controlling, etc.) can also be used to address issues related to the outsourcing of individual logistics operations in real time. This tool will enable increase the efficiency of objective management decisions, as well as eliminate the influence of the human factor;

7) The implementation of these proposals will undoubtedly achieve a synergistic effect: powerful reduction of time expenses (is very critical in conditions of active combat operations), achieving high quality logistics operations, reducing the prime cost of operations (especially one-time operations or functionally unacceptable for military units), quick reaction to changing conditions, etc.

Of course, the start of such a project (including the described key elements) of the logistical support system of the Armed Forces units for military operations requires a powerful analysis, time and information base. However, each cycle of further application of the project will require only a certain

adjustment of the procedures at the "entrance". But "at the exit" the army received: partial functional unloading of both units as a whole and individual personnel units; reduction of financial costs for logistics; faster response to changing conditions; higher degree of control over the implementation of coordination of logistics flows in space and time, etc.

These advantages will have a positive impact on the development of the military potential of the state as a whole. It should be clarified that the above proposals do not in any way contradict the creation of the Armed Forces of Ukraine of a new structure on procurement, joining the support and supply services, but only complement it. However, we have the opportunity to accelerate the practical implementation of NATO Logistics standards.

A more detailed study of the mechanism of functioning of the logistical support system of the Armed Forces units, as well as the conditions and tools of its functioning will be continued in future studies and presented in future publications.

.

References

1. Alkema, V.H. (2011) *Systema ekonomichnoi bezpeky lohistychnykh utvoren: monografiy* [The system of economic security of logistics entities]. Krok University of Economics and Law, Kyiv, Ukraine
2. Alkema, V.H. (2015) "The potential of the economic security system of the freight forwarding company". Project management and production development. [Online], vol.3, p.43-60, available at: http://nbuv.gov.ua/UJRN/Uprv_2015_3_7.
3. Grigorak, M. Yu. (2017), *Intelektualizatsiya rinku logistichnih poslug: kontseptsiya, metodologiya, kompetentnist: monografiy* [Intellectualization of the logistics services market: concept, methodology, competence], Sik Grup Ukrayina, Kyiv, Ukraine.
4. Kostiuchenko L., Solomon D. (2020) "The basic terminology of the modern military logistics". Intellectualization of logistics and Supply Chain Management. [Online], vol.1, p.91-98, available at: <https://smart-scm.org/en/journal-1-2020/lesia-kostiuchenko-solomon-dmitry-the-basic-terminology-of-the-modern-military-logistics/> (Accessed 30 May 2020). DOI: <https://doi.org/10.46783/smart-scm/2020-1-8>

5. Kostiuchenko, L. (2020), "The methodology of enterprise logistic activity strategic analyse", *Efektivna ekonomika*, [Online], vol. 5, available at: <http://www.economy.nayka.com.ua/?op=1&z=7872> (Accessed 20 Jul 2020).
6. Kulyk, V.A., Grigorak, M.Iu. and Kostiuchenko (2013), *Lohistychnyi menedzhment* [Logistics management], Logos, Kyiv, Ukraine.
7. Mikalo, O.I. (2014), "The matrix method for estimating the reasonability of outsourcing in industrial enterprises". *Efektivna ekonomika*, [Online], vol. 1, available at: <http://www.economy.nayka.com.ua> (Accessed Jun. 2014).
8. NATO Logistics Handbook (1997), Third Edition: October 1997, [Online], available at: <https://www.nato.int/docu/logi-en/logist97.htm>
9. Newsletter (2019) *Bila knyha – 2018. Zbroini Syly Ukrainy* [White Book – 2018. Armed Forces of Ukraine], Ministry of Defence Ukraine. [Online], available at: <https://www.mil.gov.ua/content/files/whitebook/WB-2018.pdf>
10. Resolution of the Cabinet of Ministers of Ukraine №1208 / 2018 "The order of logistical support of the defense forces during the implementation of tasks for the defense of the state, protection of its sovereignty, territorial integrity and inviolability" of Des 27, 2018, [Online], available at: <https://zakon.rada.gov.ua/laws/show/1208-2018-%D0%BF#Text>
11. Scientific and practical webinar "Improving the logistics of the Armed Forces of Ukraine based on the experience of the joint forces operation". (Jun 24, 2020), National University of Defense of Ukraine named after I. Chernyakhovsky. [Online], available at: <https://nuou.org.ua/u/news/naukovo-praktichnij-vebnar-%E2%80%99Cudoskonalennya-logstiki-zbrojnih-sil-ukr.html>.
12. Ukrainian Military Pages (2016) *Stratehichnyi biuleten 2016: systema lohistyky i systema medychnoho zabezpechennia* [Strategic Bulletin 2016: logistics system and health care system], [Online], available at: ukrmilitary.com/2016/12/logistic.html – Name from the screen.
13. Ukrainian Military Pages (2020) *ZSU ochikuie velyke pereformatuvannia – plan na 10 rokiv* [The AFU expects a major reformatting – a plan for 10 years] of Jan 11, 2020, [Online], available at: <https://www.ukrmilitary.com/2020/01/new-army.html>

UDC 004.932

DOI: <https://doi.org/10.46783/smart-scm/2020-2-3>

JEL Classification: D 29, E 29, F 20, L 89, O 14.

Received: 28 July 2020

Marchuk V.Ye. Doctor of Engineering, Associate Professor, Professor of Logistics
Department National Aviation University (Ukraine)

ORCID – 0000-0003-0140-5416

Researcher ID – S-6514-2018

Scopus author id: 56246790900

Harmash O.M. PhD (Economics), Associate Professor, Associate Professor of Logistics
Department National Aviation University (Ukraine)

ORCID – 0000-0003-4324-4411

Researcher ID – I-4542-2018

Scopus author id: –

Ovdiienko O.V. PhD student, Assistant at Logistic Department at National Aviation
University (Ukraine)

ORCID – 0000-0003-2770-4895

Researcher ID – S-6493-2018

Scopus author id: –

WORLD TRENDS IN WAREHOUSING LOGISTICS

Marchuk Volodymyr, Harmash Oleh, Ovdiienko Oksana. "World Trends in Warehouse Logistics".
Logistics as well as supply chain management is a fast changing field of economic activity, because it deals with different types of companies, different goods, different countries and continents, different cultures and management styles. It is reasonable that further prosperity of such entities are impossible without tracking modern trend and innovative technologies, which are providing the opportunity to rise, develop and stay profitable. Warehouse logistics is an essential part of companies' activity and takes on a significant part of the costs. Following the main worlds trend and their implementation designed to improve the financial result and quality of services. That's why this paper is devoted to analysis of the warehousing logistics innovative development and the ways how to reach it, of the most progressive world trends, namely robotics (manipulator robots, palletizer robots, sorting robots, mobile robotic carts, etc., due to whom automation of warehouse operations is carried out), Big Data (as an efficient processing of structured and unstructured huge amounts of analytical data from various sources coming at high speed), electronic data exchange technology – EDI (allows to automate the creation, sending, receiving and processing of any electronic documents and integrate them with existing business applications), drones (automated unmanned aerial vehicles, which can be used in the warehouse to gain access to goods at high altitudes, where other modes of transport will not be able to get), Internet of Things (IoT, which would give the opportunity to maintain communication between sites or premises and to control business processes of the warehouse complex), additive technologies (allows to create the

necessary products and various components using 3D-printing technology), etc. Moreover, it is not only given the general characteristic of each type of innovative ways of developments, but also presented the advantages, disadvantages and prospects of using global trends in warehousing infrastructure. It is shown that implementation of modern technological solutions and automation of processes promotes the development of multi-storey warehouses.

Keywords: world trends; innovative developments; warehousing logistics; automation; digital technologies; processes.

Марчук Володимир, Гармаш Олег, Овдієнко Оксана. «Світові тренди складської логістики». Логістика та управління ланцюгами поставок завжди були швидко змінними сферами економічної діяльності, оскільки постійно працюють з різними типами компаній, різними товарами, різними країнами та континентами, різними культурами та стилями управління. Цілком зрозуміло, що подальше процвітання таких організацій неможливе без відстеження сучасних тенденцій та інноваційних технологій, які надають можливість рости, розвиватися та залишатися прибутковими. На складську логістику припадає значна частина не лише операційної діяльності компаній, але і загальних витрат. Відслідковування основних світових трендів та їх впровадження у своїй діяльності покликане покращити фінансовий результат та якість пропонованих послуг. Саме тому особлива увагу у статті надана аналізу інноваційного розвитку логістики складських приміщень та шляхів її досягнення, найбільш прогресивних світових тенденцій, а саме робототехніці (роботи-маніпулятори, роботи-палетизатори, сортувальні роботи, мобільні роботизовані візки тощо, завдяки яким впроваджується автоматизація складських операцій), Big Data (ефективна обробка структурованих та неструктурованих аналітичних даних з різних джерел, що надходять з високою швидкістю), технологія електронного обміну даними - EDI (дозволяє автоматизувати створення, відправлення, отримання та обробку будь-яких електронних документів та інтеграція їх до існуючого програмного забезпечення), безпілотники (автоматизовані безпілотні літальні апарати, які можна використовувати на складі для отримання доступу до товарів на великій висоті, куди не зможуть дістатися інші види транспорту), Інтернет речей (IoT, що дасть можливість підтримувати зв'язок між різними приміщеннями складу та контролювати бізнес-процеси всього комплексу), адитивні технології (дозволяють створювати необхідні продукти та їх комплектуючі за допомогою технології 3D-друку) тощо. Також надано не лише загальну характеристику кожного типу інноваційних шляхів розвитку, але й проаналізовано переваги, недоліки та перспективи використання світових трендів у складській інфраструктурі. Показано, що впровадження сучасних технологічних рішень та автоматизація процесів сприяє розвитку багатоповерхових складів.

Ключові слова: світові тренди, інноваційні розробки, складська логістика, автоматизація, цифрові технології, процеси

Марчук Владимир, Гармаш Олег, Овдиенко Оксана. «Мировые тенденции в складской логистике». Логистика, а также управление цепочками поставок - это быстро меняющаяся сфера экономической деятельности, поскольку она имеет дело с разными типами компаний, разными товарами, разными странами и континентами, разными культурами и стилями управления. Разумно, что дальнейшее процветание таких предприятий невозможно без отслеживания современных тенденций и инновационных технологий, которые дают возможность расти, развиваться и оставаться прибыльными. Складская логистика является неотъемлемой частью деятельности компаний и берет на себя значительную часть расходов. Следование основным мировым тенденциям и их реализация призваны улучшить финансовый результат и качество услуг. Именно поэтому данная статья посвящена анализу инновационного развития складской логистики и путей ее достижения, самых прогрессивных мировых тенденций, а именно робототехнике (роботы-манипуляторы, роботы-штабелеры, сортировочные роботы, мобильные роботизированные тележки, использование которых обеспечивает автоматизацию складских операций), Big Data (как эффективная обработка структурированных и неструктурированных

огромных объемов аналитических данных из различных источников, поступающих с высокой скоростью), технология электронного обмена данными - EDI (способ автоматизировать создание, отправку, прием и обработку любых электронных документов и интеграция их с существующими бизнес-приложениями), дроны (автоматизированные беспилотные летательные аппараты, которые можно использовать на складе для получения доступа к товарам на больших высотах, где другие виды транспорта не работают), Интернет вещей (IoT, который дает возможность поддерживать связь между помещениями склада и контролировать бизнес-процессы всего комплекса), аддитивные технологии (создание необходимых продуктов и различных их компонентов с использованием технологии 3D-печати) и т. д. Кроме того, в статье не только дана общая характеристика каждого типа инновационных способов развития, но и представлены преимущества, недостатки и перспективы использования мировых трендов в складской инфраструктуре. Показано, что внедрение современных технологических решений и автоматизация процессов способствует развитию многоэтажных складов.

Ключевые слова: мировые тренды, инновационные разработки, складская логистика, автоматизация, цифровые технологии, процессы.

Introduction. The dynamics of the world business ecosystem development is characterized by rapid development in recent years. To gain a competitive advantage, maintain their market position and generate additional profits, the world's leading corporations are thinking about using the innovative technologies and solutions potential that are rapidly changing not only business methods but also the essence of the product offered to the end user.

One of the focuses of close attention is warehousing logistics, which always remains a pool of costs (for example, Amazon lost about \$ 7 billion in logistics in 2017), and often the cost of delivery significantly exceeds the revenue from the delivery itself [1].

Modern warehouses, as the most important component of warehousing logistics, are a complex technical structure, which includes a number of interacting and complementary elements of the logistics system, providing the functions of accumulation, processing and distribution of goods between end users. The warehouse is considered as an integrated component of the logistics chain, which allows to achieve a high level of profitability. Warehousing and processing of goods are important components of the logistics activities of retailers, manufacturers, distributors and

industrial enterprises. The cost of their implementation absorbs up to 40% of logistics costs.

The area in which warehousing logistics has the greatest influence today, where turnover is growing in the fastest way, is e-commerce online retail. The global e-commerce market continues to grow at a steady pace: in 2018 its volume increased by 18%, and the total value of all online orders amounted to \$ 2.86 trillion. Thus, according to EVO business, in 2018, compared to previous year, the e-commerce market in Ukraine grew by a third - up to UAH 65 billion and was expected to continue to grow in 2019 not so fast - by 25%. According to Gartner, by 2020, online retailers who have personalized their service through artificial intelligence technologies will increase profits by 15%. Confirmation of this can be seen now: when the online store Very.co.uk made a home page that adapts to weather conditions, its revenue jumped by € 5 million [2, 3].

The spread of COVID-19 and related quarantine measures have increased the share of e-commerce in the overall structure of commercial real estate. This gave impetus to the creation of a developed logistics and terminal-warehousing infrastructure, and also to the changes in the warehouse real estate market in the direction of increasing demand for warehouses premises (Fig. 1).

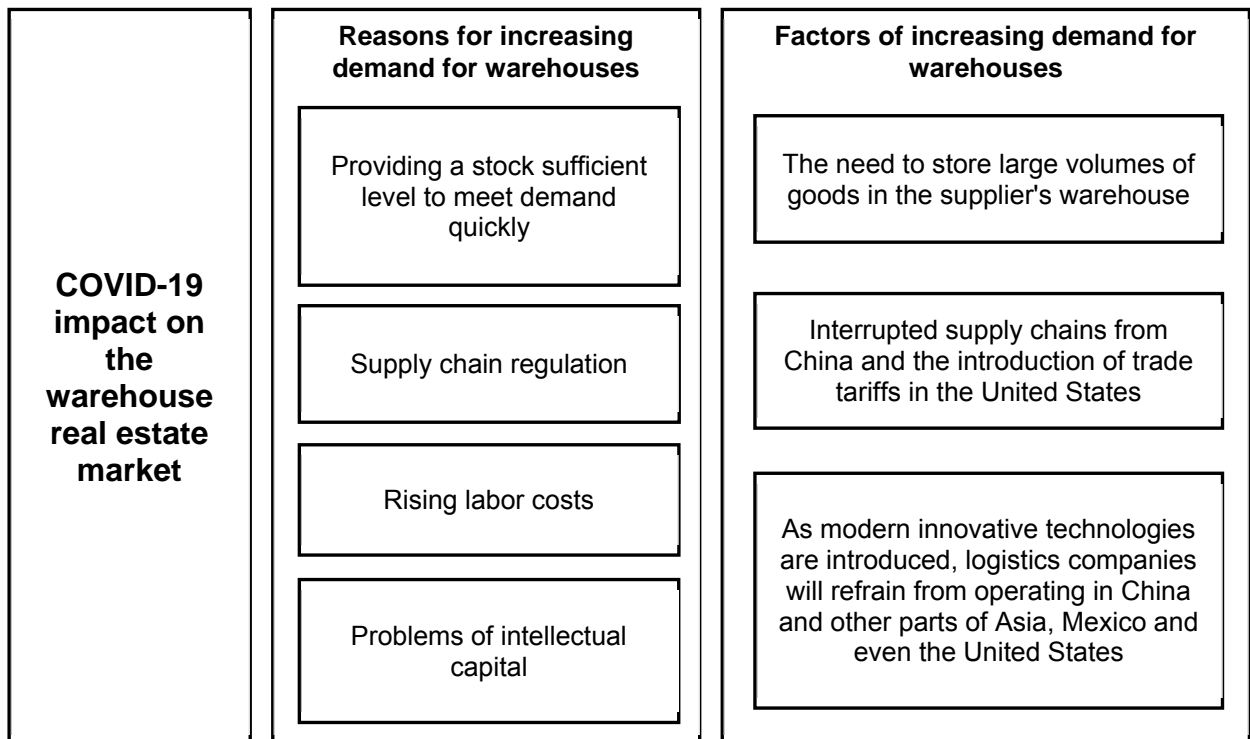


Fig. 1. Impact of COVID-19 spread and related to it quarantine measures on the warehouse real estate market (compiled on the basis of [4])

But despite this, among the main barriers to the development of e-commerce online retail could be noted the imperfection of the logistics process in the warehouse, errors and low speed of order processing. To develop online sales, it is needed to change the common technological approach used in warehousing and distribution. It should be aimed at the introduction of modern and promising innovations, global trends in the field of warehousing logistics.

The aim of the article. Analysis and development trends of promising global trends in the field of warehousing logistics.

The main material. The warehousing logistics development is impossible to imagine today without the use of modern innovative technologies and solutions. This is due to the active development of both domestic and global markets, as well as the rapid development of warehousing infrastructure (terminal warehouses, logistics

centers). Innovative technologies are aimed at automating internal warehousing, integration of logistics business processes that ensure the interaction of all participants in the logistics chain in the supply and distribution of finished products.




Recent advances in artificial intelligence and automation, as well as the ever-increasing capabilities of intelligent devices have created completely new conditions for revolutionary changes in the development and application in warehousing logistics of promising global trends based on innovative nature (Table 1).

The use of robots plays an important role in increasing the level of warehouse automation, which is becoming a global trend today. Robotization, according to FNC experts, will be the leading driver of business over the next five years, along with such trends as global distribution platforms and digital identifiers [5]. This is due to the need to




accelerate logistics business processes in large warehouses, where human capabilities have reached the limit. Inventory management with robotic systems eliminates possible errors and accidents and simplifies most processes. Integration of software and

hardware solutions for efficient accounting and management of major warehousing processes accelerates warehousing operations, reduces the amount of routine work and increases staff efficiency.



Table 1.

World trends in warehousing logistics			
Technology	General description	Advantages	Disadvantages
Robotization 	With the help of warehouse robots (manipulator robots, palletizer robots, sorting robots, mobile robotic carts, etc.) automation of warehouse operations is carried out	1. Eliminates mistakes, reduces defects and minimizes accidents and risks to people. 2. Accelerates the efficiency of warehousing operations. 3. Increases productivity, reduces costs	1. Problems of providing navigation inside warehouses. 2. Insufficient development of technologies
Big Data 	Efficient processing of structured and unstructured huge amounts of analytical data from various sources coming at high speed, using horizontally scalable software tools for their further effective application	1. Minimization of human involvement in the decision-making process. 2. Continuous self-learning process to optimize business processes in the warehouse. 3. Analysis of results and implementation of necessary changes (forecast of fluctuations in demand, detection of seasonality, adjustment of processes in the warehouse, etc.)	1. Not fully used the potential of technology. 2. Risks that may arise during the collection, processing and use of data
Radio frequency identification – RFID 	Uses radio waves to record and read information stored on labels attached to the product. Widely used in warehousing, and in the coming years will become more perfect	1. Fuller control and greater transparency of inventories. 2. Reduction of inventory stock-taking. 3. Reduction of theft	Increased costs compared to paper medium

Continuation of the table 1.

<p>Electronic data exchange technology - EDI</p> 	<p>Allows to automate the creation, sending, receiving and processing of any electronic documents and integrate them with existing business applications between the computer systems of the customer and the contractor in a structured digital form based on standard formats</p>	<p>1. Allows to significantly speed up document management processes. 2. Increase sales to retailers and purchases from suppliers. 2. Reduces the number of human errors in the execution of documents in the warehouse. 3. Reduces inventory. 4. Optimizes goods delivery routes to customers</p>	<p>Low level of information security</p>
<p>Drones</p> 	<p>Automated unmanned aerial vehicles, which can be used in the warehouse to gain access to goods at high altitudes, where other modes of transport will not be able to get. The real scope of drones is inventory stock-taking.</p>	<p>1. Flexibility of goods storage at height. 2. Reduction of time for inventory stock-taking</p>	<p>1. Limited safety when moving. 2. Imperfection of energy sources. 3. Insufficient power and autonomy. 4. Restriction of orientation in space by GPS indoors. 5. Lack of legal framework</p>
<p>Internet of Things (IoT)</p> 	<p>Would give the opportunity to maintain communication between sites or premises and to control business processes of the warehouse complex, productivity, energy costs, track stocks of resources and materials, improve customer service, efficiency of warehouse equipment, monitor the safety and work of warehouse staff</p>	<p>1. Real-time control of business processes. 2. Ensuring security and reliable safety. 3. Improving the efficiency of warehouse equipment. 3. Implementation of successful business models. 4. Improving the quality of customer service and minimizing risks in case of unforeseen circumstances</p>	

End of table 1.

<p>Additive technologies</p> 	<p>Allow to create the necessary products and various components from metals, plastics, mixed materials and even human tissues in layers on the basis of computer 3D-model using 3D-printing technology at the request of customers, which will reduce the supply chain, eliminating the need to store large volumes of finished products in warehouses</p>	<ol style="list-style-type: none"> 1. Increasing the speed of production and reducing costs. 2. Customer orientation: without the material resources spending, the consumer can make individual changes to the product. 3. Opportunity for companies to abandon outsourcing after the transition to 3D printing. 4. Reduction of negative impact on the environment 	<ol style="list-style-type: none"> 1. Limited product sizes. 2. High cost of some materials used for printing. 3. High energy consumption of production. 4. Relatively narrow choice of materials
<p>Cross-docking</p> 	<p>The process of acceptance and shipment of goods through the warehouse without placement in the area of long-term storage</p>	<ol style="list-style-type: none"> 1. The cost of processing the goods decreases. 2. The minimum period of goods staying in the warehouse. 3. The turnover of warehouse space is growing. 4. Reducing warehousing costs 	<ol style="list-style-type: none"> 1. It is necessary to constantly analyze consumer demand for products. 2. The incoming goods must be immediately ready for shipment or require minor additional operations. 3. The need for well-managed organization of traffic flows
<p>Multi-storey warehouses</p>	<p>Represents the multi-storeyed construction in which access to floors is organized, as a rule, on a ramp that gives the chance to divide warehouse area on separate warehouses</p>	<ol style="list-style-type: none"> 1. Low operating costs. 2. Decrease delivery costs and reduction of delivery time due to proximity to potential customers. 3. Ability to use the whole modern infrastructure complex 	<ol style="list-style-type: none"> 1. High capital costs for construction. 2. The need for higher energy capacity. 3. Additional costs for support and modernization technological and operational systems

In general, there are three main groups of robots that are currently used in warehouses for moving goods: Automated Guided Vehicle, Autonomous Mobile Robots, automated warehouse forklifts RLT (Robotic Lift Truck). With new advances in navigation technology and functionality, companies are beginning to use robots in warehouses for a variety of operations, namely: loading, moving, unloading, packaging, depalletizing, sorting, packaging, inventory stock-taking.

In its report on the future of warehouse automation ("The Future of Warehouse Automation - 2019"), the specialized analytical agency Interact Analysis singled out the introduction of mobile robots that displace traditional conveyor systems as a trend #1 [6]. The robots are already used by many foreign manufacturers to perform such

simple tasks as cleaning the floor, issuing orders, checking and tracking the location of goods on the shelves, etc.

From the point of view of digital transformation of business, autonomous mobile robots in warehouses provide the mechanism of autonomous data collection on movement of materials and use of stocks within the limits of warehouse operations. In addition, the integration of robots with operational-level systems such as WMS (Warehouse Management System) and WES (Warehouse Execution System) will help align between the physical execution of tasks and a digital copy of the operation in Digital Twins systems.

Now there are more than 30 manufacturers of logistics robots. Some developments are given in table. 2.

Table 2.

Promising world developments of warehouse robots

Purpose of the robot	Producer	General description	Source
Robot loader Handle version	American company Boston Dynamics	The robot loader is equipped with a manipulator with suction cups, which are used to capture and hold the boxes. The on-board robot inspection system tracks marked pallets for navigation and finds separate boxes to capture and move. When the robot places the boxes on the pallet, it uses force control to press each box to the next. It can simultaneously lift a load of up to 15 kg inclusive. This version of the robot is able to work with pallets with a depth of 1.2 m and a stack height of 1.7 m.	[7]
SpotMini security robot	American company Boston Dynamics	Amazing mobility and "passability". Can deftly go up and down the stairs, and, if necessary, open the locked door	[8]
Digit robot courier	Ford Company	The robot looks like a human, has two legs and a pair of arms that can not only lift weights, but also catch falling objects. The robot can navigate in space and in complex situations, including stairs and blockages in the room.	[9]

End of table 1.

Robot-assembler	British company Ocado	The robot moves along the paths on the upper tiers, selects containers and sends them to the sorting point, where the order is completed. The special lattice design allows to work at the same time more than one thousand robots which pass on 60 km with a speed of 4 m/s each. Thanks to automation, the selection and packaging of goods takes about 5 minutes.	[10]
-----------------	-----------------------	--	------

Several robot manufacturers from different countries, including Kiva (now called Amazon Robotics), Swisslog and Grenzbach offer robotic solutions that speed up inventory stock-taking and ordering processes. At the same time, the analytical agency Interact Analysis emphasizes that the acquisition of Kiva Systems by Amazon gave rise to two significant trends in the warehouse logistics market [11]: first, the vacuum, created after the departure of Kiva, was very quickly filled with new players; second, the event forced retailers and logistics companies

to implement automation to keep up with Amazon. The agency predicts an explosion of growth in the installed base of autonomous mobile robots for the warehouse (not including Amazon) - 100 thousand in 2020 and about 600 thousand - in the next 5 years.

Comparative forecast of Interact Analysis by types of warehouse robots showed that it is the decision to move goods and equipment, according to analysts, will account for the bulk of the projected growth in robot production (Fig. 2).

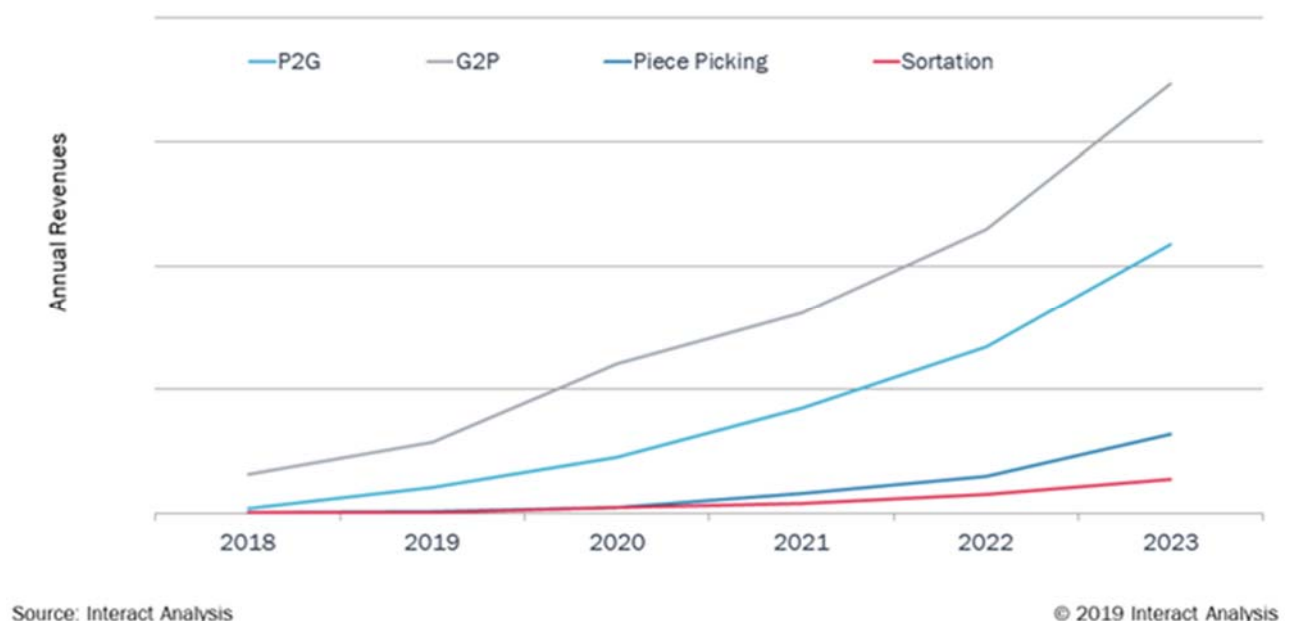


Fig. 2. The trend of production growth by types of robots: 1- P2G - Person-to-Goods; 2- G2P - Goods-to-Person; 3- Piece Picking - Artificial Selection; 4- Sortation - Sorting (Source: interactanalysis.com) [11]

The number of Amazon's warehouse robots is many times greater than the total worldwide. According to the Associated Press at the end of 2019, Amazon were using more than 200,000 warehouse robots, doubling its fleet compared to the end of 2018. In 2014, there were 15 thousand of them [12].

According to the NYT, without robots Amazon would not be able to cope with current tasks and deliver goods quickly. A study by Deutsche Bank showed that the cycle of Amazon Robotics takes 15 minutes, while people - 60-75 minutes. In addition, robotic warehousing systems reduce operating costs by 20%. The robots also relieve the workload of employees and helps save space in warehouses. A smart cargo transportation system does not require the extra free space that people would need to approach the shelves. Despite this pace of robotics, Amazon continued to hire new employees. Since the advent of Kiva robots, the company has hired 80,000 warehouse workers in the United States alone. Currently, the warehouses employ 125 thousand workers, but soon their number will increase, and work tasks will change [13].

Warehouse robotization also covers other global technology trends, namely: Big Data, the Internet of Things, unmanned vehicles and other technologies.

Big data is a term that describes the large volume of data – both structured and unstructured – that inundates a business on a day-to-day basis. But it's not the amount of data that's important. It is what organizations do with the data that matters, these data are efficiently processed by horizontally scalable software tools that appeared in the late 2000s and alternatives to traditional database management systems and solutions of the class "Business Intelligence". [14]. In fact, Big data is an alternative to traditional data management systems.

In a broad sense, "Big data" could be interpreted as a socio-economic phenomenon associated with the emergence of technological capabilities to analyze huge

data sets, in some problem areas for their further effective application. [15].

The term "Big data" was coined by Nature's editor Clifford Lynch back in 2008 in a special issue on the explosive growth of global information. According to experts, more than 2.5 exabytes are generated every day. By 2020, every inhabitant of the planet will generate about 1.7 megabytes of data every second and humanity will generate 40-44 zettabytes of information. And according to IBS forecasts, by 2025 the entire global data volume will increase 10 times, compared to 2020. Data will become a vital asset, and security - a critical foundation of life. The technology will change the economic landscape, and the average user will communicate with connected devices about 4800 times a day [16].

In the near future, Big Data will be actively used in warehousing logistics. Analytics of big data will allow to predict fluctuations of demand, to reveal seasonality, to correct processes in a warehouse (the forecast of loading of reception and marking, smoothing of peak hours), etc. By means of Big Data it is possible to construct multifactor model results. In addition, it stores information not only about all products, their location, movement, but also a huge amount of additional data: all clicks in the interface, delivery schedule, weather, customer information, distance of suppliers from the warehouse (Fig. 3). At the same time there is a continuous process of self-learning. That is, the machine itself learns (the principle of Machine Learning) in real time and creates algorithms for optimizing business processes.

The principle of Big Data technology is based on the maximum informing the user about an object or phenomenon. The task of such acquaintance with data is to help to weigh all "pros" and "cons" to make the correct decision.

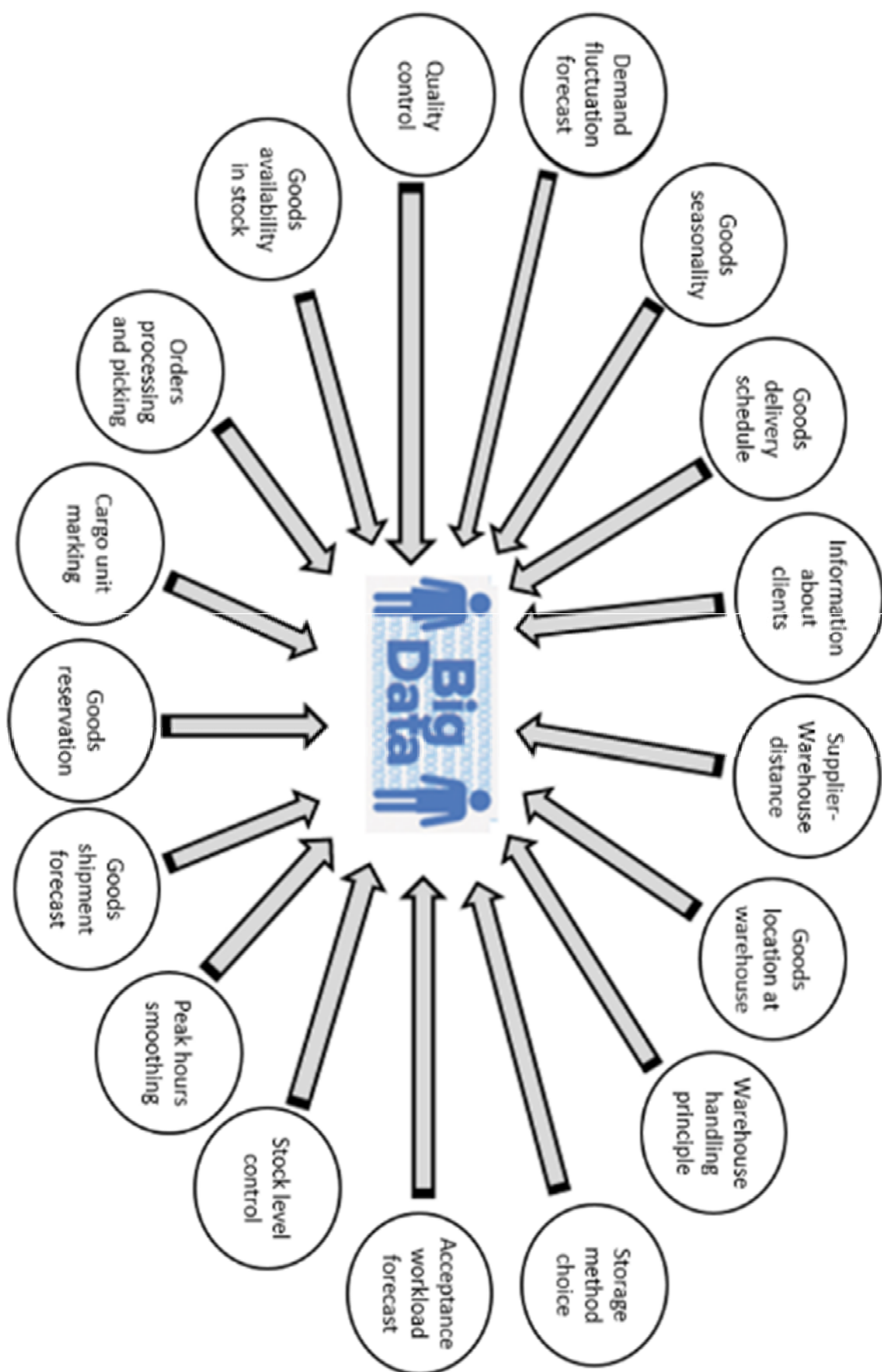


Fig. 3 – Big Data in warehouse logistics

In intelligent machines, a model of the future is built on the basis of an array of information, and then various options are simulated and the results are tracked. In an ordinary warehouse, such analytics allows to learn about the most popular products and store them close to the assembly lines, as well as to place similar goods or goods in high demand together in one part of the warehouse. This allows to complete orders with maximum speed. At the same time, the

collected orders are immediately sorted by regions, transport companies, dimensions. All this increases the speed of processing and shipment by at least 30%.

The basic principles of working with Big data (Table 3) differ from traditional, centralized, vertical models of storage of well-structured data. Accordingly, new approaches and technologies are being developed to work with Big data.

Table 3.

Basic principles of working with big data (built on data [17])

Principle	Characteristic
<i>Horizontal scalability</i>	Increasing the number of computing nodes with the growth of big data should not impair the performance of data processing
<i>Fault tolerance</i>	Methods of working with big data should take into account the probability of failure of computer nodes of machines and provide preventive measures
<i>Data locality</i>	It is desirable to process big data on the same server on which it is stored to save time, resources, data transfer costs.

McKinsey, an international consulting firm specializing in strategic management,

identifies 11 methods of analysis that can be applied to Big data (Table 4).

Table 4.

Methods of Big data analysis (based on data [16])

Methods of analysis	Characteristic
Data Mining methods (data mining, in-depth data analysis)	A set of methods for identifying previously unknown, non-trivial, practically useful knowledge needed for decision-making. Such methods, in particular, include teaching associative rules, classification (division into categories), cluster analysis, regression analysis, detection and analysis of deviations, and others.
Crowdsourcing	At the heart of this technology is the ability to receive and process streams in billions of bytes from many sources. The final number of "suppliers" is not limited to anything if only to the power of the system
Data fusion and integration	A set of technical solutions that allows to integrate disparate data from different sources for in-depth analysis
Machine learning	Using models based on statistical analysis or machine learning to obtain comprehensive forecasts based on core models
Artificial neural networks, network analysis, optimization	Heuristic search algorithms used to solve optimization and modeling problems by random selection, combination and variation of the required parameters using mechanisms similar to natural selection in nature

End of table 4.

Pattern recognition	Identify an object or determine any of its properties by its image, audio recording, or other characteristics
Forecasting analytics	Analysts try to set certain parameters for the system in advance and then check the behavior of the object based on the receipt of large arrays of information
Simulation	Allows to build models that describe the processes as they would take place in reality
Spatial analysis	A class of methods that use topological, geometric, and geographic information extracted from data
Statistical analysis	Time series analysis, A / B testing (A / B testing, split testing - a method of marketing research; when used, the control group of elements is compared with a set of test groups in which one or more indicators have been changed to find out which of the changes improve the target)
Visualization of analytical data	Presentation of information in the form of figures, diagrams, using interactive features and animation both to obtain results and for use as source data for further analysis. Allows to present the most important results of the analysis in the most convenient form

The effectiveness of Big Data technology and analysis tools in the warehouse implies the presence of a built-in logistics management system (which can be a source of data), formalized business processes, awareness of the need for additional data and motivation to use them in decision making.

The next global trend of warehousing logistics is the technology of electronic data exchange - EDI (Electronic Data Interchange), which allows to automate the creation, sending, receiving and processing of any electronic documents and integrate them with existing business applications. It supports the exchange of data between the customer's and contractor's computer systems in a structured digital form based on standard formats. In the process of sending documents, EDI translates the information into a standard format, saving the content.

EDI is used to exchange purchase order documents, shipment orders, warehouse receipts, shipment notices, etc. This significantly reduces the time to fill in the tables and compare data, reduces the number of human errors in the execution of documents in the warehouse, reduces inventory, optimizes routes for delivery of goods to customers.

For example, the Vehicle Loading setting [18] allows to transfer data for each individual pallet of both one and a group of orders; split orders between multiple vehicles. In addition, the customer sees the volume of shipped pallets online, and recipients know about the contents of each pallet before the arrival of the vehicle.

To implement EDI, it is necessary that all trading companies have an international identification number - GLN, and each product must have a global GTIN in the international system EAN (GS1). EDI operates on any platform: mainframe, client-server, personal computer. In general, the choice of platform for EDI depends on the specific needs of the company, the volume of transactions and the number of partners involved in the EDI project.

EDI exchange is based on the use of international standards designed to meet all possible requests. The application of standards increases the security of EDI-data transmission based on the principles (Table 5), which allow reliable transmission of electronic exchange documents over the Internet. This allows companies to improve management and control processes, significantly reduce warehousing costs.

Table 5.

Principles of EDI data transmission	
Principle	Characteristic
Delivery guarantee	Automatic notification of the sender about receipt
Efficiency	About 170 types of messages are processed and transmitted within 10 minutes
Accuracy	Complete elimination of errors is achieved already at the stage of data input that considerably reduces time for an information exchange between contractors.
Economy	Allows to minimize the costs associated with the preparation of documents up to 7-10% of the total cost of the transaction
Confidentiality of information	Warrant the security of commercial information transmission is ensured through data encryption and the use of Internet standards for EDI
Certainty	Provided by the use of notifications about the location of messages for checksums and completely eliminates the possibility of making changes to the document without the knowledge of the recipient

The Center for the Simplification of Procedures and Practices in Management, Trade, and Transport (CEFACT) has been operating at the United Nations since 1997 to address the compatibility of international standards with US and European standards. The RosettaNet standard is currently being actively improved. In 1998, 40 of the world's leading IT organizations founded the non-profit consortium RosettaNet, one of the largest projects in the field of data exchange standardization, which continues to develop. It aims to globalize supply chains in the IT industry and bring companies from America, Europe, Japan, Korea, Singapore and Taiwan into a single e-commerce network. In particular, Intel, using the global RosettaNet infrastructure, reduced the average time to receive orders from the customer from 12 hours up to a few minutes [19].

Electronic document management (EDI) systems have been actively used in Ukraine since 2005. To date, most retail chains, manufacturers and distributors in Ukraine have switched to modern technologies to support commercial transactions. The use of EDI technologies to service legally significant document circulation is also becoming more widespread. Among the largest retailers that use EDI in Ukraine (according to Comarch) are:

"METRO Cash & Carry Ukraine", GC Fozzy Group, "Velyka Kyshenia", "Auchan", "ATB", "Watsons", "Furshet", "WOG", "PACCO", "Tavria B", "Caravan" ("Retail Group of Ukraine"), Billa, "Obzhora" and many others. Business documents, such as: orders, shipment notifications, acceptance certificate, invoice, analogues of tax and goods invoices, sales report and stock balances in the warehouse and others, exchanged by retailers, manufacturers, distributors, logistics operators - can be transmitted using EDI technology (electronic data interchange) [20].

EDI technologies are still the most important element of medium and large companies' activity, which can significantly speed up document management processes, increase sales to retailers and purchases from suppliers, reduce inventory, optimize routes for delivery of goods to customers. Current trends are such that in the next few years EDI will remain the main driving force of the e-commerce market.

Radio Frequency Identification (RFID) is widely used in warehousing logistics, which will become more and more advanced in the coming years. RFID technology uses radio waves to record and read information stored on labels attached to the product. The benefits of RFID include greater control and

greater transparency of inventory, which ensures ease of inventory stock-taking, as well as reduced theft.

Today, logistics companies are trying to combine drone technology with RFID in order to further automate the inventory process. RFID in combination with the maneuverability of drones will optimize the size of warehouse space by increasing the height of storage and significantly reduce the time spent on inventory stock-taking. When using drones, there is no need to remove pallets from a height, to attract additional staff, to spend a lot of time on the recalculation of products, the human factor is excluded completely.

It is important to note that it is used not only for the inventory stock-taking of pallets for high-altitude storage. As a result of high-altitude miscalculation, the availability of free storage spaces is detected and additionally confirmed. Both of these processes - inventory stock-taking and confirmation of vacancies allow to ensure further trouble-free work with replenishment, placement, acceptance of stocks [21].

With clear advantages (mobility, efficiency, cost and low payback time), there are a number of factors that limit the widespread use of drones in warehouses, namely: energy imperfections, insufficient power and autonomy, limited orientation in space by GPS indoors, lack of legislation.

Nowadays, these problems of drones are being actively addressed. So the modularity of drones allows to solve the problem with additional batteries. Recently, local positioning systems have been launched that allow the replacement of the GPS drone module with internal positioning. With the help of open SDKs, third-party programmers can interact with drones, assign them flight routes, receive data from scanners (cameras) of RFID tag readers, integrate existing WMS.

The Massachusetts Institute of Technology is testing a new system with small drones and RFID tags to monitor inventory. According to the research team, the most difficult task in developing a system that uses RFID is to find a way to make it secure. Drones,

which are safe enough to fly in close proximity to humans, are usually small and light with plastic rotors. Unfortunately, these drones cannot carry RFID readers over long distances [22].

At LogiMAT in Stuttgart, Linde MH, a manufacturer of equipment and solutions for the warehouse, presented a prototype Flybox drone for work in the warehouse. The combination of a drone and a robotic stacker into a single system ensures uninterrupted power supply to the drones (usually the drone battery lasts for about 15 minutes) and constant tracking of the location of drones without the use of GPS within the warehouse space. Thanks to the innovative geological steering system, the developed Linde control system determines exactly where the drone is at a certain point of time [23].

At the Munich exhibition Transport Logistic 2017, the development of Fraunhofer IML - a ball drone "Bin: Go" was presented. A feature of this drone is the ability to work near humans. The spherical structure closes the structural elements of the drone and prevents the possibility of injury to a person in a collision, as well as allows the drone to move on the floor surface [24].

Of course, drones and robots are just the most effective part of the Internet of Things (IoT) technology that a modern warehouse can be equipped with. DHL and Cisco estimate that IoT technology will generate about \$ 8 trillion assets in the next ten years, of which \$ 1.9 trillion will have to logistics and supply chain management. The impact of the Internet of Things on the logistics sector cannot be overestimated. Solutions of this kind are beginning to be used both in warehousing operations and in the transportation of goods and for "last mile" delivery [25].

IoT solution in warehousing logistics allows to optimize the use of warehouse space, monitor the integrity of goods and other tangible assets, improve customer service, improve the efficiency of warehousing equipment, assess and improve

the quality and safety of warehouse workers, conduct a "smart" stock-taking.

Thus, most modern warehouse complexes are already equipped with Warehouse Management Systems (WMS), which receive data from barcodes and RFID-tags placed on the packaging of goods. A more advanced level is Warehouse Control Systems (WCS). To determine the optimal capacity and speed of storage equipment (from forklifts and ending with conveyor belts), they are equipped with controllers and sensors. Also with the help of cameras located in the warehouse and in the area of shipment, it's possible to detect violations of the integrity of packaging, products.

Some warehouses are equipped with Building Automation Systems (BAS). Such systems can use special sensors to monitor and control lighting, air conditioning and ventilation, as well as ensure the operation of security subsystems and access control to the warehouse. Modern WMS, WCS and BAS systems are equipped with interactive interfaces - dashboards that allow warehouse workers to effectively manage the warehouse complex. Internet of Things technologies combine the data of these systems, provide their cross-interaction to solve more complex problems. For example, in the case of storage of perishable products that require a special temperature regime, the BAS system can monitor temperature fluctuations in the warehouse through sensors. And, if it has reached critical values, send a signal to the WMS system, and in turn - to inform warehouse workers about the situation [25].

Additive technologies are one of the main world trends, which is actively implemented in warehousing logistics. They allow almost any company to create products or parts of products from metals, plastics, mixed materials and even human tissues in layers based on a computer 3D model using 3D printing technology.

3D-printing technology significantly expands the production process, making it independent of specialized industries and enterprises. This will allow manufacturers to

"print" the necessary products and various components on demand, which will reduce the supply chain, eliminating the need to store large volumes of finished products in warehouses [26].

The introduction of 3D printing for the logistics industry has huge growth potential. The logistics provider will be able to supply raw materials instead of finished products, provide 3D printing services at delivery points, which will be an additional source of income. For such purposes it will be possible to use the electronic library of projects, available on a local computer, and print the part. Worn parts can be scanned in 3D-mode and re-created.

Recently, additive technologies are developing rapidly in various industries. Thus, experts from the University of Wollongong (Australia) in 2015 introduced the first 4D printer that can print such details that will take into account the time factor, such as adapting to temperature variability [27]. To expand the possibilities of 3D printing in the food industry, a team of Korean scientists led by Jin-Kyu Rhee from Ewha Women's University developed and created a food printing system that allows to accurately control the composition and texture of food. The new technology allows to obtain food products with the required content of nutrients, with a given texture and controlled digestion rate [28].

A popular area of 3D-technologies application in Ukraine is the repair and direct production of equipment, namely: printing of parts and mechanisms that need immediate replacement. An example is Privatbank, which purchased a 3D printer and began printing gears for ATMs. Thanks to 3D printing, the cost of their production has decreased 20 times. In addition, the bank no longer needs to maintain stock - gears are printed as needed [29].

Lately, cross-docking or Merge-in-Transit (MIT) technology has become increasingly popular in warehousing logistics. This is primarily due to the reduction of costs in the organization of warehousing operations by

20-30%, which is due to the lack of storage space. That is, the process of acceptance and shipment of goods through the warehouse is carried out without placement in the area of long-term storage.

Unlike the traditional warehouse complex, which implies the availability of inventory that the distributor can send to customers, the functions of the cross-docking center are end-to-end warehousing, i.e. receiving, sorting and shipping parcels without placing in a long-term storage area. A feature of these properties is the low rate of land use, as they must provide the necessary free space for travel and maneuvering of trucks and vans [30].

In other words, cross-docking is essentially a Just-in-Time production system adapted for warehousing operations, when storage costs are reduced during the movement of cargo. Cross-docking provide the opportunity to speed up the delivery of goods to the final consumer, which is especially important when working with perishable products.

Newly, the number of cross-docking distribution centers located along city borders has been growing rapidly. They are focused on the delivery of "last mile" logistics and are the last link between the supplier and the final consumer of goods.

The trend towards the introduction of modern technological solutions and automation of processes will promote the development of multi-storey warehouses. The practice of building multi-storey warehouses first developed in Asia, where rapid economic growth and industrialization of the economy took place against the background of acute shortage of land resources and a sharp rise in land prices. As a result, Asian industrial warehouse real estate began to grow. So today, the average height of a warehouse building in Hong Kong is 12 floors, in Tokyo and Singapore - 5 floors.

In the United States is actively building multi-storey warehouses. In 2018, several sources reported that Amazon is going to build six automated multi-storey fulfillment

centers in different regions of the United States. For example, in Minnesota, in the suburbs of Minneapolis, a 4-story warehouse Project Hotdish with a total area of 240 thousand m² is being built, in Charlotte (North Carolina) it is planned to build a multi-storey fulfillment center Project Quattro with a total area of about 230 thousand m² [30].

Access to the floors in a multi-storey warehouse is organized on a ramp, which makes it possible to divide the area of the building, in fact, into separate warehouses. Cargo is delivered to the upper floors by trucks, where there are unloading docks for their maintenance. Although it should be noted that the first multi-storey warehouses in Asia used freight elevators to move goods on the floors. According to forecasts, in the near future multi-storey warehouses will become a more common solution for the European logistics market, at least near or in large cities. In this case, large cities are megacities with extremely high land values. In small towns, the construction of a multi-storey warehouse is likely to be economically impractical.

Simulation technologies today are also an innovative approach to organizing the work of the warehouse and are designed in most cases for large customers with complex logistics processes. With the help of simulation, a virtual model of real processes and warehouse topology is created, which allows to quickly analyze and demonstrate to customers in the dynamics of development various options for improving the efficiency of warehouse business processes and, consequently, minimize costs. At the same time, up-to-date data on the required number of personnel, trucks and workload of different storage areas are promptly collected. The received information allows to estimate efficiency of variants, to calculate time of operations performance, to calculate expenses and to choose optimum algorithms of management and the organization of cargo flows [31].

Conclusions. The development of digital technologies has greatly influenced the

innovative solutions in the field of logistics, which change the technical and economic structure of many economies around the world. Warehouse logistics was one of the first to respond to systemic changes in technology and introduced elements of robotics and artificial intelligence. Due to the emergence of modern world trends, namely: robotics, Big Data, electronic data exchange technology -

EDI, drones, Internet of Things (IoT), additive technologies, etc. the efficiency of warehouse and supply chain management increases, especially for non-standard solutions, which significantly stimulates the market; accelerates the efficiency of warehousing operations, optimization of inventories in the supply chain, increases productivity and quality, reduces costs, etc.

References

1. First National Consulting Group. (2018) New technologies in warehouse operations. [Online] Available from: <https://www.fnc-group.ru/novie-technologii-v-skladskix-operaciyax.html>.
2. SHISHKIN Y. (2019) Ten online retail trends for 2019-2020. Vc.ru. [Online] Available from: <https://vc.ru/trade/59300-desyat-trendov-onlayn-riteyla-na-2019-2020-gody>
3. ZLATEVA D. (2019) By seven-league crocs: outcomes of Ukrainian e-commerce and logistics for 2018. Association of retailers in Ukraine, rau.ua [Online] Available from: <https://rau.ua/novyni/itogi-e-commerce-2018/>
4. 100realty.ua (2020) The spread of COVID-19 will increase the demand for warehouses within the city: how the market will change. [Online] Available from: <https://100realty.ua/news/rasprostranenie-covid-19-uvelicit-spros-na-sklady-v-predelah-gorodak-izmenitsa-rynok>
5. First National Consulting Group. (2018) New technologies in warehouse operations: Basic business trends and tendencies. Available from: <https://www.fnc-group.ru/novie-technologii-v-skladskix-operaciyax.html>
6. SCRIVEN R. Report The Future of Warehouse Automation – 2019. InteractAnalysis [Online] Available from: <https://www.interactanalysis.com/the-future-of-warehouse-automation-2019-2/>
7. Boston Dynamics. Handle Robot reimaged for Logistics [Online] Available from: <https://www.bostondynamics.com/handle>
8. Logist.Today (2019) Boston Dynamics has developed a warehouse loader robot. [Online] Available from: https://logist.today/dnevnik_logista/2019-04-04/boston-dynamics-razrabotali-skladskogo-robota-gruzchika/
9. KOVALCHUK I. (2019) Amazing technologies and inventions. Ecotech.news [Online] Available from: <https://ecotech.news/technology/114-nova-sluzhba-dostavki-v-diji-bezpilotnij-furgon-robot-kur-er.html>
10. RoboHunter (2018) Robots in a warehouse: Ocado showed how an automated supermarket in Andover works. [Online] Available from: <https://robo-hunter.com/news/roboti-na-sklade-ocado-pokazala-kak-rabotaet-avtomatizirovannii-supermarket-v-andovere11053>.
11. SHARMA A. (2019) Order Fulfilment Mobile Robots Start to Deliver – more than 500,000 to be installed in next 5 years. InteractAnalysis [Online] Available from: <https://www.interactanalysis.com/order-fulfillment-mobile-robots-start-to-deliver-more-than-0-5m-to-be-installed-in-next-5-years/>
12. KUVSHYNOV M. (2020) Warehouse robot market trends. RoboTrends. [Online] Available at: <http://robotrends.ru/pub/2007/trendy-rynka-skladskih-robotov>.

13. KRASYLNIKOVA Yu. (2017) The number of robots in Amazon warehouses has reached 100,000. Hightech.Fm [Online] Available from: https://hightech.fm/2017/09/15/amazon_robot_workers.
14. Big Data. What it is and why it matters Sas.com [Online] Available from: https://www.sas.com/en_us/insights/big-data/what-is-big-data.html
15. MAIER-SHENBERGER V., KUKER K. (2014) Big Data. A revolution that will change the way we live, work and think. Mann, Yvanov, Ferber, — 240 p.
16. BERKANA A. (2017) What is Big data: collected all the most important things about big data. Rusbase [Online] Available from: <https://rb.ru/howto/chto-takoe-big-data/>.
17. PETROV A. (2015) Big Data from A to Z. Part 1: Principles of working with big data, the MapReduce paradigm. DCA (Data-Centric Alliance) [Online] Available from: <https://rb.ru/howto/chto-takoe-big-data/>
18. PIDVYSOTSKYI D. (2018) Innovative solutions in warehouse logistics: myths, facts, trends. Logistics in Ukraine [Online] Available from: <https://logistics-ukraine.com/2018/04/27>
19. OpenGL. Electronic data exchange technology [Online] Available from: <https://www.opengl.org.ru/informatsionnye-sistemy-i-tehnologii/tehnologiya-elektronnogo-obmena-dannymi.html>
20. Comarch EDI. Business of the future: EDI technologies in the Ukrainian market. Comarch experience. TradeMasterGroup [Online] Available from: <https://trademaster.ua/recomendacii/1489>
21. Puchenkov V. (2017) Use of drones in warehouses. Logistics [Online] Logistika-prim.ru (6) – P. 16–17.
22. DroneExpo (2017) MIT drones conduct warehouse inventory using RFID tags [Online] Available from: <https://drone-expo.ru/ru/article/uchyonie-mit-razrabotali-sistemu-dlya-dronov-kotoraya-pomoget-avtomatizirovat-inventarizatsiyu-74261>
23. LindeMaterialHandling (2017) Drones are the warehouse technology of the future [Online] Available from: <https://www.linde-mh.ru/novost-1/>
24. WRYCZA P. Bin:Go – Die rollende Transportdrohne. Fraunhofer-Institut für Materialfluss und Logistik IML [Online] Available from: https://www.iml.fraunhofer.de/de/abteilungen/b1/verpackungs_und_handelslogistik/forschungsprojekte/bingo.html.
25. SIMAKINA A. (2016) Smart Warehouses: How Sensors, Robots and Drones Are Changing Logistics. lot.ru [Online] Available from: <https://iot.ru/riteyl/umnye-sklady-kak-sensory-roboty-i-drony-menyayut-logistiku>.
26. DMITRIEV Ye. (2019) Five new technologies that will change logic forever. Ati.su [Online] Available from: <https://news.ati.su/article/2019/04/09/5-novyh-tehnologiy-kotorye-navsegda-izmenyat-logistiku-094000/>
27. ALEKSANDROVA K. Logistics without logisticians. RZD Partner [Online] Available from: <http://www.rzd-partner.ru>.
28. DUBOV A. (2018) 3D printer adapted for printing food from cryogenic flour. Nplus1.ru [Online] Available from: <https://nplus1.ru/news/2018/04/25/3d-printing-food>.
29. Androshchuk H.A. (2017) Additive technologies: perspectives and problems of 3D printing. Science, technologies, innovations (1) – P. 68-77.
30. SkladmanUSG (2019) Market overview of Multi-Storey and High-Bay Warehouse [Online] Available from: [Byklet_Skladu_L_15.03.19_v15.pdf](#).
31. Logistics.ru. Warehouse innovations will allow customers of 3PL services to reduce costs by up to 40% [Online] Available from: <https://logistics.ru/warehousing/news/skladskie-innovacii-pozvoljat-klientam-3pl-uslug-snizit-do-40-zatrat>

UDC 338.47:656.613

DOI: <https://doi.org/10.46783/smart-scm/2020-2-4>

JEL Classification: L91, M21, R41.

Received: 29 July 2020

Patkovskyi Sergii. Business practitioner. Business development manager, emerging markets Kuehne + Nagel Inc., Chicago, IL USA

ORCID – 0000-0002-5369-7580

Researcher ID –

Scopus author id: –

Lytvynenko S.L. PhD (Economics), Associate Professor, Associate Professor of International Economics Department National Aviation University (Ukraine)

ORCID – 0000-0001-7185-1193

Researcher ID – R-6986-2018

Scopus author id: 36573718100

THE WAYS OF SUPPLY CHAIN RESPONSIVENESS INCREASE AT TIME OF PORT INFRASTRUCTURE AND TRANSPORTATION ASSETS PRODUCTIVITY DISRUPTION

Sergii Patkovskyi, Sergiy Lytvynenko *"The Ways of Supply Chain Responsiveness Increase at Time of Port Infrastructure and Transportation Assets Productivity Disruption"*. The article determined that the delivery of goods by sea to the United States has its peculiarities and nuances. Specific trends over the last few years which have led to a number of supply chain disruptions have been described. An analysis of previous research has shown that the issue of increasing of the supply chain responsiveness in terms of reducing port infrastructure and transportation assets has been studied insufficiently. The volumes of traffic through US ports for the last three years were analyzed. It was identified that inefficiency in operation leads to an increase in inventories and immobilization of cash flows, as well as increased transportation, storage and demurrage costs. The complexity of the processes requires a systematic approach to reducing the main risks and building a multi-scenario model of operation with a flexible supply chain. The system of strategic and tactical measures for US shippers has been developed to reduce key risks. At the strategic level, it was proposed to implement a system of 3-4 distribution centers linked to supply chains on both coasts of the United States; ability of capacity variation; availability of 1-2 intermodal distribution centers; availability of alternative routes and ports of arrival, as well as various vehicles; maximum reliability of the last mile; real-time process management including the use of outrunning indicators to trace shifts. It was proposed to implement the tactical level through operations planning and increase in time of placing seafreight bookings and inland transport allocation; realization of the opportunity to choose alternative services by balancing actual supply and demand; reducing capacity constraints by using multiple routes and ports of arrival; active use of services for accelerated full container load for goods that are sensitive to time fluctuations; preventing container dwells. The dynamics of containers dwell time served in the port Los Angeles in 2018 during the trade war between the US and China was analyzed and the impact of new tariffs on imports of steel and aluminum products imported from abroad, as well as a wide range goods made in China was determined. A case study of 6250 shipments from China ports to the port of Los Angeles was conducted, dividing them to containers terminated at port of arrival and containers moved

intermodally to inland terminals (dry ports) by rail. Storage periods peaked in the fourth quarter, when the number of containers that spent over 10 days and over 20 days doubled in each consecutive month.

Keywords: supply chain, responsiveness, seaport, trade war, cargo, disruption, transport assets productivity.

Сергій Патковський, Сергій Литвиненко «Шляхи підвищення стійкості ланцюга поставок при перебоях в продуктивності морських портів та транспортних активів». У статті було визначено, що доставка вантажів морем до США має свої особливості та нюанси. Було охарактеризовано специфічні тенденції за останні кілька років, які призвели до ряду перебоїв у ланцюгах поставок. При аналізі попередніх наукових досліджень виявлено, що проблема підвищення стійкості ланцюга доставки за умов скорочення транспортних ємностей та зменшення пропускної спроможності морських портів вивчена недостатньо. Проаналізовано обсяги перевезень вантажів через порти США за останні три роки. Визначено, що неефективність роботи призводить до збільшення інвентарних запасів і іммобілізації грошових потоків, а також збільшення витрат на перевезення, зберігання, демаредж та детеншін. Складність процесів вимагає системного підходу до зниження основних ризиків та вибудовування багатосценарної моделі роботи із гнучким ланцюгом постачань. Розроблена система стратегічних та тактичних заходів для вантажовідправників США з метою зведення ключових ризиків. На стратегічному рівні запропоновано реалізацію системи із 3-4 дистрибуційних центрів, які пов'язані з ланцюгами постачань на обох узбережжях США; можливість варіювання ємностями; наявність 1-2 розподільчих центрів; наявність альтернативних маршрутів та портів прибуття, а також використання різних класів транспортних активів; максимальна надійність останньої милі; керування процесом у реальному режимі часу, в тому числі і шляхом використання випереджаючих індикаторів для відстеження змін. Тактичний рівень запропоновано реалізовувати шляхом операційного планування та збільшення термінів розміщення замовлень на морські перевезення і розподіл по внутрішньому транспорту; реалізації можливості вибору альтернативних сервісів морських ліній виходячи з фактичного балансу попиту і пропозиції; зменшення обмежень транспортних ємностей шляхом використання декількох маршрутів і портів прибуття; активного використання послуг з прискореного хендлінгу контейнера для товарів, які чутливі до часових коливань; унеможливлення простою контейнерів. Було проаналізовано динаміку часу затримки для контейнерів, які були обслужені в порту Лос-Анджелеса у 2018 році під час торговельної війни між США та Китаєм та виявлено вплив нових тарифів на широкий асортимент товарів, вироблених в Китаї. Проведено дослідження 6250 відправок з портів Китаю в порт Лос-Анджелес. Вони були розділені на контейнери, що термінуються в порту прибуття, і контейнери, що переміщуються в інтермодальних сполученнях на внутрішні термінали (сухі порти) залізницею. Періоди зберігання досягли свого піку в четвертому кварталі, коли кількість контейнерів, які провели більше 10 днів і більше 20 днів, подвоювалося в кожному наступному місяці.

Ключові слова: ланцюг постачання, стійкість, морський порт, торгівельна війна, вантаж, збій, продуктивність транспортних активів

Сергей Патковський, Сергей Литвиненко «Пути повышения устойчивости цепи поставок при перебоях в продуктивности портов и транспортных активов». В статье было определено, что доставка грузов морем в США имеет свои особенности и нюансы. Были охарактеризованы специфические тенденции за последние несколько лет, которые привели к ряду перебоев в цепях поставок. При анализе предыдущих научных исследований выявлено, что проблема повышения устойчивости цепи доставки в условиях сокращения транспортных емкостей и уменьшения пропускной способности морских портов изучена недостаточно. Проанализированы объемы перевозок грузов через порты США за последние три года. Определено, что неэффективность работы приводит к увеличению инвентарных запасов и иммобилизации денежных потоков, а также увеличение расходов на перевозку, хранение и демаредж. Сложность процессов требует системного подхода к снижению основных рисков и выстраивания много-сценарной модели работы с гибкой цепью поставок. Разработана система стратегических и тактических мероприятий для грузоотправителей США с целью сужения ключевых рисков. На стратегическом уровне предложено реализацию системы из 3-4 распределительных центров,

которые связаны с цепями поставок на обоих побережьях США; возможность варьирования емкостями; наличие 1-2 интермодальных распределительных центров; наличие альтернативных маршрутов и портов прибытия, а также различных классов транспортных активов; максимальная надежность последней мили; управление процессом в режиме реального времени, в том числе и путем использования системы опережающих показателей для отслеживания изменений. Тактический уровень предложено реализовывать путем операционного планирования и увеличения сроков размещения заказов на морские перевозки и аллоцирования транспортных емкостей для наземной перевозки; реализации возможности выбора альтернативных сервисов морских линий исходя из баланса фактического спроса и предложения; уменьшения ограничений по емкостям путем использования нескольких маршрутов и портов прибытия; активное использование «экспресс» сервисов доставки товаров в полных контейнерах, которые чувствительны к временным колебаниям; предотвращения простоя контейнеров. Была проанализирована динамика времени задержки для контейнеров, которые были обработаны в порту Лос-Анджелеса в 2018 году во время торговой войны между США и Китаем и выявлено влияние дополнительных пошлин на широкий ассортимент товаров, произведенных в Китае. Проведено исследование 6250 отправок из портов Китая в порт Лос-Анджелес. Они были разделены на контейнеры, которые следовали до порта прибытия, и контейнеры, которые перемещались в интермодальных сообщениях на наземные терминалы (сухие порты) по железной дороге. Периоды хранения достигли своего пика в четвертом квартале, когда количество контейнеров, провели более 10 дней и более 20 дней, удваивалось в каждом следующем месяце.

Ключевые слова: цепь поставок, устойчивость, морской порт, торговая война, груз, сбой, продуктивность транспортных активов.

Introduction. Over the past decade increasing the sustainability and reliability of supply chains has become key issue for all participants in the delivery process. Even a slight deviation in a certain part of the supply chain can cause catastrophic consequences for the whole chain. The key criterion of delivery efficiency is the just-in-time logistics principle. Although maritime shipping involves longer delivery times, especially compared to air transport, transit time parameters are also highly important given the planning of the entire supply chain.

Cargo shipping to the United States has its own characteristics and nuances. In addition, it should be noted that there are specific trends in this market. Last several years brought a number of disruptions to seafreight based supply chains in the US:

- Union strikes 2015;
- ELD (Electronic Logging Device) regulation implementation Q1 2018;
- emerging Trade War with China in H2 2018 when Section 301 Import Tariffs were imposed against wide variety of Chinese goods;

- COVID19 unprecedented vessel capacity removal by steam ship lines from the main trade lanes.

So, it is necessary to study in more detail the characteristics of this market and develop effective proposals to increase the sustainability and reliability of supply chains.

Literature and research review. The deepening of globalization and integration processes, the widespread use of modern information technologies determines the need to find ways to increase the sustainability of the supply chain while reducing existing risks. This is especially relevant in direction of ensuring sustainability in the face of business environment complexity and uncertainty. The issue was studied by many researchers, namely Mota B., Gomes M.I., Carvalho A., Barbosa-Povoa A.P., Lee H.L., Shen Z.-J., Lee H., Gillai B., Chen Y., Rammohan S. Mota B. et al. [1] focused on creating an appropriate decision-making support tool to provide sustainable supply chain designing and planning taking into account economic, environmental and social aspects. The application of the offered tool was considered through a case-study of the

company with a head office in European region.

Lee H. et al. [2] devoted their research to global supply chain and logistics improvement for better service and customer satisfaction, in particular through deregulation, trade liberalization, e-commerce development, formation of multinational logistics alliances and networks targeted to the development of the U.S.-China B2C sector. Lee H.L. and Shen Z.-J. [3] studied innovations introduced into supply chains and logistics in the framework of the Belt and Road Initiative in China. Implementation of such a project contributed to the improving interaction between business representatives and providing better value. The authors analyzed international cooperation and supportive adjustments in carrying out supply chain improvements. Also risk management in supply chain is essential for optimal operational performance, that was noted by Munir et al. [4]. Authors offered the decision-making framework considering the links and dependencies between supply chain risk management and integration. Xu M. et al. [5] designed the framework for evaluating risks in supply chains based on economic, social, and environmental sustainability dimensions.

Peculiarities of improving supply chains and providing sustainable operation of seaports are considered by a number of researchers and practitioners. Hossain N.U.I. et al. [6] analyzed the interconnection between waterway port infrastructure and adjusting supply chain causing failures in the system. The evaluation model can be used as a tool for decision-making in eliminating critical risks in performance. Oh H., Lee S.-W., and Seo Y.-J. [7] conducted analysis of South Korean port sustainability indicators in terms of its competitiveness, optimization of resource allocation and operational improvement. The authors, like most other researchers, identified economic, social, and environmental dimensions of sustainability. Baert L. and Reynaerts J. [8] devoted their study to aspects of factors competition

between ports, outlining port charges and congestion as main factors in decision making of port users. Based on this, optimal logistics can be ensured.

Identification of port hinterlands and their overlapping was done on the example of Chinese foreign trade container ports for perspective seaport development and operation planning in terms of infrastructure improvement by Wan S. et al. [9]. The paper reveals the features and importance of interconnection and cooperation between international hub ports, regional hubs, and feeder ports. Han C.-H. [10] also highlighted the importance of integration to ensure port supply chain effective and quality performance (case of Busan container ports). Ascencio L.M et al. [11] concentrated their study on proposals on introducing modern supply chain management practices based on multilateral collaboration for the port development.

Another aspect of port community system development was considered by Moros-Daza A. et al. [12]. Authors conducted multivariate analysis for the purpose of developing specific IT tool that will help to reduce seaport costs and increase its competitiveness. Essential components of seaport sustainability are environmental factors. In this direction, research was carried out by Notteboom T. et al. [13], giving comprehensive study of perspectives and methods of interaction between port actors in the region in terms of green supply chain management. Sustainability of the seaport cannot be provided without elimination of critical risks in supply chain. Thus, the appropriate tool for risk management should be used. In particular, Jiang B., Li J., and Shen S. [14] offered an AHP method for this issue to increase port efficiency.

Despite the significant amount of research and their importance, the issue of increasing the supply chain responsiveness in terms of port infrastructure and transportation assets productivity reduction has been insufficiently studied.

Aim and objectives. The purpose of this article is to identify ways to increase the responsiveness of the supply chain at time of US ports infrastructure and transportation assets productivity disruption using systematic approach in main risks mitigation, strategical and tactical measures.

Results, analysis and discussion. Events that cause disruptions for inbound seafreight emerge in cycles fashion and can be recognized as systematic risks exposures for supply chain going forward. One of the fundamental reasons for this is natural constraints of further US ports infrastructure development. There is simply no lots of land available to build and put new sea port terminals in operation. Present bandwidth

can cover normal case operations volume and encounters congestion or clogging at time of inbound containers volume spike.

US inbound seafreight volume developments were determined by quite strong consumption and retail sales 2017 through 2019 (Table 1). Growth pace accelerated by mid of 2018 driven by US shippers advancing their cargo and outrunning actual demand. This was caused by 301 Import Tariff Section imposed by White House administrations as of Jan 1 2019. Cargo advances resulted in 8.48% growth year over year according to 20 largest US ports study conducted. However, with gradual decline in 2019 it is obvious that previous year increase was rather reflected in inventory stocks than in actual sales numbers.

Table 1.

Volumes of traffic through US ports (2017-2019 years)

PORT OF ARRIVAL / QUARTERS	2017 Q1, TEU	2017 Q2, TEU	2017 Q3, TEU	2017 Q4, TEU	2018 Q1, TEU	2018 Q2, TEU	2018 Q3, TEU	2018 Q4, TEU	2019 Q1, TEU	2019 Q2, TEU	2019 Q3, TEU	2019 Q4, TEU	Total, TEU
PORTS TOTAL													
LOS ANGELES, CA	1 066 891,803	1 145 150,31	1 231 091,469	1 233 260,699	1 058 064,691	1 150 753,034	1 262 219,423	1 365 775,284	1 062 653,666	1 173 507,012	1 302 693,478	1 128 073,736	14 180 134,604
LONG BEACH, CA	769 342,221	984 343,24	1 070 916,882	984 162,133	930 153,13	1 069 932,885	1 046 615,138	1 061 397,754	845 600,309	931 688,675	998 163,157	935 527,936	11 627 843,461
NEW YORK/NEWARK AREA/ NEWARK, NEW JERSEY	747 946,11	832 459,029	891 552,783	869 034,214	849 390,474	873 291,266	950 646,209	965 073,171	883 149,145	926 594,496	973 681,703	938 083,552	10 700 902,151
SAVANNAH, GA	431 035,327	461 206,579	492 784,337	480 490,632	482 173,631	507 194,312	537 653,182	553 246,812	543 933,024	531 751,445	600 881,08	541 637,752	6 163 988,114
NORFOLK, VA	288 927,102	296 495,456	323 867,882	329 695,471	305 762,006	305 652,615	337 212,344	337 445,417	312 701,934	339 662,478	348 826,076	317 747,069	3 843 995,849
HOUSTON, TX	235 771,906	265 352,026	278 650,443	282 286,465	263 233,556	287 067,046	319 284,839	310 412,506	293 369,755	315 964,412	329 200,768	303 223,745	3 483 817,466
CHARLESTON, SC	231 210,408	240 839,102	237 204,57	241 140,137	236 095,082	252 916,057	256 796,134	269 075,773	256 512,719	262 082,28	286 946,659	261 707,417	3 032 526,337
OAKLAND, CA	194 037,508	225 810,133	237 140,12	223 636,605	207 327,511	240 915,417	249 964,285	247 241,595	222 715,954	244 564,643	259 983,952	235 077,624	2 788 415,346
TACOMA, WA	224 779,65	201 862,653	195 220,065	199 989,339	176 218,842	201 832,998	211 634,466	222 722,867	183 640,073	204 077,199	224 274,337	209 049,403	2 455 301,891
SEATTLE, WA	121 628,218	158 002,763	173 020,535	171 715,904	155 064,898	178 249,582	195 606,708	206 104,225	163 345,681	161 378,457	163 404,68	129 015,754	1 976 537,405
PORTS TERMINATED													
LOS ANGELES, CA	798 280,022	845 559,348	920 891,332	928 481,27	779 079,867	839 716,435	963 154,756	1 022 909,315	793 535,265	865 821,486	992 311,508	848 111,557	10 597 851,981
NEW YORK/NEWARK AREA/ NEWARK, NEW JERSEY	648 132,874	709 843,117	762 052,381	735 303,962	714 036,795	724 884,904	796 097,631	812 930,71	740 004,867	775 899,682	821 434,813	787 403,093	9 028 024,83
LONG BEACH, CA	554 936,125	721 290,535	796 846,345	741 375,684	680 841,442	779 381,026	806 270,814	828 687,897	648 956,758	727 319,997	794 741,191	748 119,489	8 828 767,302
SAVANNAH, GA	380 332,881	403 889,961	434 413,515	422 284,307	417 055,813	434 052,44	460 625,121	474 136,608	463 546,996	453 895,448	520 194,785	466 526,598	5 330 954,474
HOUSTON, TX	220 829,441	248 434,847	262 371,402	266 107,794	249 067,367	270 422,89	301 867,937	293 043,201	275 457,566	297 961,826	310 644,204	285 728,414	3 281 936,889
NORFOLK, VA	214 939,609	220 843,693	243 864,599	253 178,538	234 035,047	226 173,043	256 059,363	258 693,396	234 390,69	250 606,909	267 155,118	243 154,627	2 903 094,632
CHARLESTON, SC	194 137,113	205 393,83	200 836,951	207 050,198	201 221,403	216 733,364	219 806,827	229 572,868	217 603,088	220 453,865	243 390,76	221 895,075	2 578 095,344
OAKLAND, CA	178 304,661	207 172,00	217 847,722	205 665,528	190 506,724	222 875,44	232 608,807	231 507,622	207 227,979	226 817,158	240 799,682	215 447,569	2 576 780,891
TACOMA, WA	136 225,851	131 790,118	133 596,839	138 146,266	120 962,621	137 927,016	142 066,405	151 270,526	121 080,797	132 463,066	151 122,447	144 731,778	1 641 383,73
SEATTLE, WA	96 964,907	120 017,418	131 871,478	125 436,747	114 175,789	125 877,098	136 852,492	146 116,374	119 588,996	118 003,946	123 594,992	100 016,089	1 458 516,327
CY TERMINATED CARGO													
CHICAGO, IL	222 968,012	242 281,99	249 824,15	250 243,402	241 489,261	268 457,731	251 621,625	254 726,54	224 930,31	238 404,129	234 998,728	207 869,222	2 887 815,10
DALLAS/FT. WORTH, TX	80 214,412	106 018,204	103 233,72	103 916,532	91 918,772	115 928,363	106 804,005	121 638,427	91 944,824	111 950,111	107 258,619	101 517,873	1 242 343,862
MEMPHIS, TN	56 799,197	64 943,618	67 514,345	61 448,216	63 311,564	73 313,105	67 003,545	72 036,092	60 603,282	64 853,62	63 377,011	58 692,003	773 895,599

End of Table 1.

ATLANTA,GA	42 222,417	48 370,697	45 145,443	45 240,799	47 433,847	56 534,703	57 295,082	64 298,934	51 427,091	53 116,233	54 217,049	51 084,501	616 386,798
KANSAS CITY,MO	39 666,212	45 598,081	46 392,294	47 356,593	48 863,577	54 074,141	50 131,839	54 181,029	47 689,032	53 041,588	51 200,931	49 504,164	587 699,481
COLUMBUS,OH	39 115,487	39 803,008	42 774,178	41 328,275	40 550,357	46 126,342	45 764,755	48 310,895	41 044,935	42 973,236	47 739,038	45 605,91	521 136,416
CLEVELAND,OH	31 593,811	34 428,694	35 259,844	34 821,652	33 793,116	37 228,337	35 494,465	37 963,026	32 045,043	34 757,239	34 282,201	31 864,642	413 532,07
ST. LOUIS,MO	22 748,315	25 688,339	28 366,328	25 973,564	25 680,874	27 701,158	29 076,485	30 438,563	25 444,84	29 324,122	28 965,217	25 894,587	325 302,39
DETROIT,MI	22 661,67	23 757,052	23 847,699	23 985,345	25 520,769	28 831,145	25 676,798	25 775,194	23 536,388	24 275,102	21 908,774	19 520,766	289 296,70
CINCINNATI-LAWRENCEBURG,OH	20 629,541	22 449,142	23 532,726	23 113,613	21 308,236	25 360,218	24 848,511	25 526,957	21 457,976	23 250,654	25 060,751	24 562,242	281 100,568

Source: US Customs and Border Protection AMS data

Volumes of traffic between the largest US ports of containerized cargo present in Table 2.

Table 2.

Volumes of traffic between the largest US ports of containerized cargo (2017-2019 years)

PORT OF ARRIVAL / QUARTERS	2017 Q1, TEU	2017 Q2, TEU	2017 Q3, TEU	2017 Q4, TEU	2018 Q1, TEU	2018 Q2, TEU	2018 Q3, TEU	2018 Q4, TEU	2019 Q1, TEU	2019 Q2, TEU	2019 Q3, TEU	2019 Q4, TEU	Total, TEU
CONTAINER YARD CHICAGO													
LOS ANGELES,CA	64 862,742	64 311,18	67 847,137	71 802,669	68 126,528	72 186,972	64 045,978	71 435,235	60 896,416	63 831,223	65 536,909	56 872,15	791 755,14
LONG BEACH,CA	56 121,793	74 643,22	80 015,611	67 657,60	72 203,056	79 488,857	62 170,198	58 697,977	53 174,683	54 298,748	51 483,542	45 551,463	755 506,748
NEW YORK/NEWARK AREA, NEWARK, NEW JERSEY	30 782,454	35 472,566	37 019,986	41 095,082	40 831,023	45 764,65	45 107,45	46 742,467	44 287,915	47 145,237	44 032,672	44 109,021	502 390,521
TACOMA,WA	35 895,744	24 531,999	20 934,246	22 221,793	19 655,30	23 450,732	26 298,602	27 422,449	22 711,777	25 799,559	31 409,23	27 194,97	307 526,401
NORFOLK,VA	23 359,446	25 296,384	24 744,989	24 184,706	21 425,078	24 486,783	26 174,954	24 651,606	25 677,103	30 547,274	25 108,985	22 069,412	297 726,719
CONTAINER YARD DALLAS													
LOS ANGELES,CA	46 026,715	62 070,427	57 953,344	61 767,833	49 805,734	65 760,752	63 310,366	79 697,382	57 015,878	73 281,736	65 123,477	62 706,526	744 520,172
LONG BEACH,CA	29 444,07	38 902,445	40 129,714	37 597,019	37 588,391	45 431,357	38 704,815	36 376,266	30 054,647	34 599,582	37 132,72	34 604,171	440 565,198
HOUSTON,TX	3 898,873	4 285,382	4 235,177	3 766,332	3 601,912	3 603,30	3 744,70	3 735,131	3 679,372	2 237,702	1 908,948	2 448,925	41 145,755
SAVANNAH,GA	476,00	323,026	423,673	386,589	462,132	696,942	629,953	618,96	691,11	611,97	571,01	469,05	6 360,414
NEW ORLEANS,LA	125,25	102,75	158,25	119,00	156,50	148,50	165,03	1 018,97	294,00	974,25	2 041,51	992,50	6 296,51
CONTAINER YARD MEMPHIS													
LOS ANGELES,CA	25 883,643	25 212,176	26 952,997	24 336,64	24 478,578	27 840,134	26 049,102	31 405,239	23 653,908	25 851,435	26 076,299	23 778,828	311 518,979
LONG BEACH,CA	19 993,699	27 541,313	26 901,729	21 913,222	24 648,883	31 198,368	24 784,646	23 037,201	18 503,157	20 335,417	18 249,656	16 985,087	274 092,377
SAVANNAH,GA	5 922,117	7 001,16	8 389,877	9 397,09	9 031,46	8 598,424	9 364,227	8 734,955	10 505,945	9 829,226	11 366,682	10 830,423	108 971,585
CHARLESTON,SC	2 692,639	2 396,481	2 206,502	2 724,752	2 437,246	2 637,975	2 765,724	3 357,075	3 555,442	3 932,652	3 297,576	2 906,273	34 910,337
SEATTLE,WA	0,00	183,00	308,257	413,00	217,49	351,00	2 214,82	3 408,404	2 237,614	2 589,839	1 972,347	1 315,707	15 211,477
CONTAINER YARD ATLANTA													
SAVANNAH,GA	25 753,189	28 297,988	26 020,48	26 216,358	31 482,295	38 374,017	37 439,303	41 619,292	38 195,381	38 462,181	38 987,17	36 471,237	407 318,89
LOS ANGELES,CA	6 316,425	7 462,494	6 582,996	7 486,195	6 053,981	7 109,501	7 822,072	9 698,523	5 710,056	8 232,301	8 285,925	7 102,066	87 862,534
LONG BEACH,CA	5 962,20	7 883,218	7 441,39	6 638,987	6 037,451	6 551,865	7 403,723	8 263,484	3 450,807	2 410,293	2 520,301	2 620,21	67 183,929
CHARLESTON,SC	1 996,129	2 185,368	2 493,42	2 302,652	1 927,968	2 778,569	3 396,63	3 582,528	3 032,582	2 941,682	3 398,218	3 907,64	33 943,387
NEW YORK/NEWARK AREA, NEWARK, NEW JERSEY	759,189	1 146,826	1 014,983	1 018,053	1 034,485	1 262,753	1 000,23	902,067	900,015	1 003,441	972,435	962,349	11 976,826
CONTAINER YARD KANSAS CITY													
LOS ANGELES,CA	15 071,67	16 389,019	18 108,177	18 785,31	18 536,045	19 371,081	19 424,616	21 595,214	18 578,013	21 349,184	21 198,735	19 147,907	227 554,972
LONG BEACH,CA	14 093,156	18 193,511	17 135,654	16 268,698	17 564,497	22 259,116	17 930,876	18 782,838	15 857,201	18 316,894	16 723,18	18 335,831	211 461,454
NEW YORK/NEWARK AREA, NEWARK, NEW JERSEY	5 673,935	6 666,781	6 751,941	7 449,747	8 284,738	8 082,745	7 993,007	7 874,972	8 297,308	7 461,735	7 359,962	7 340,26	89 237,132
NORFOLK,VA	2 885,01	2 634,239	2 660,201	2 827,46	2 571,497	2 605,453	2 586,493	3 140,23	3 287,48	3 819,29	3 972,30	3 233,547	36 223,20
TACOMA,WA	1 685,69	1 130,77	894,07	959,117	965,55	945,247	1 058,317	1 528,266	1 068,78	1 415,984	1 403,00	1 146,627	14 201,417

Source: US Customs and Border Protection AMS data

Distribution of inbound container volumes that moved intermodally from main US ports of arrival to 5 largest inland container

yards (CY) is shown in Fig 1. Percentage stated represents port of arrival contribution to entire CY inbound volume.

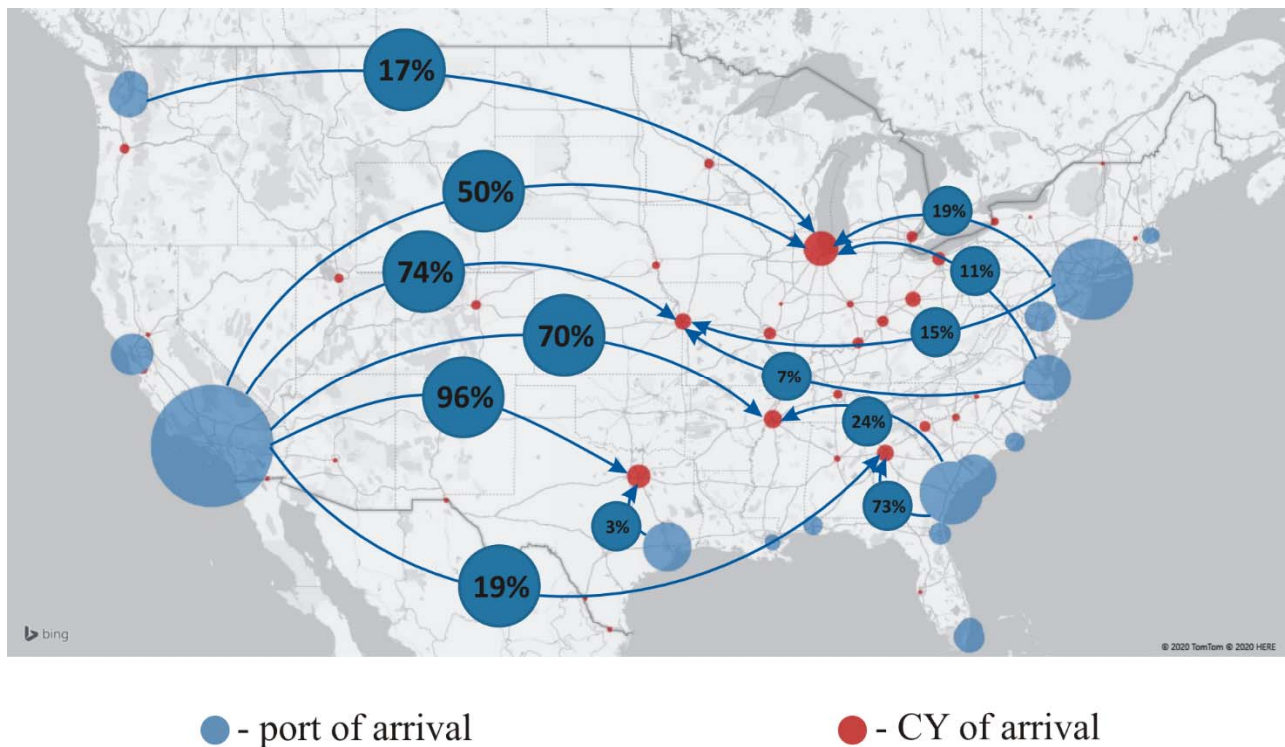


Fig. 1. Distribution of inbound container volumes that moved intermodally to inland CY

There is dual effect for US shippers caused by operational inefficiency and transport assets productivity drop. On one hand they result in increased safety inventory stocks and immobilized cash-flow, or non-satisfied ultimate customers demand usually accompanied by contract penalties. On the other hand inefficiencies produce sizeable losses for the shipper as far as extra freight charges required to get freight moving; storage, demurrage, detention charges due to increased dwell time inside and outside the terminals. Large number of various factors requires conscious and systematic approach in main risks mitigation. US shipper has to build resilient and responsive supply chain that has several operational scenarios for the goods to reach final destination in a timely fashion.

There are strategical, long term, and tactical, short, term planning implemented by US shippers in order to narrow down key risks. Seafreight delivery chain has rather long response time hence not just operational risk acknowledgment is vital but availability of tools that allow to collect and interpret data.

This helps to recognize shifts and make preventative decisions in advance. Inventory stock increase possibility is removed for the purpose of subject study.

Strategical measures:

a) 3-4 DC (Distribution Centres) locations widespread across the market, linked to both US coasts routed chains. Planning DC locations shipper considers not just bottom-line numbers and unit economy but supply risk resilience as well. Best case scenario - each main distribution regions has to be symmetrically covered by 2 out of 4 DCs. Main requirement is that each DC has to be independent and different route wise from other DCs within the network. Obviously, such model creates additional burden of overheads, operations set up and extra day to day efforts. On the other hand operating with several DCs enhance ease of inventory redistribution within the network and reversal shipments settlement. Also decentralized operational model allows to diversify the risk of disaster impact.

b) Ability to contract additional buffer capacity with the DC or 3rd party warehouse. At

time of fluctuation, seasonal goods or rapid stock inventory replenishment company strives to have extra capacity buy up possibility with existing DC landlord or in the same area. As practice shows limited warehouse capacity or systematic conflict between inbound and outbound became a main problem of operations productivity and generates sizeable transport assets detention charges for the shipper.

c) *1-2 intermodally connected DCs within supply chain.* Circumstantially intermodal operations are becoming more resilient a time of arrival port disruption; hence it is important for the shipper to have at least 1 intermodally connected DC in the network. Located within large US inland CY area this DC can be reached intermodally from the ports of both coasts, also from Canadian ports of arrival like Vancouver/Prince Rupert on the West and Halifax/Montreal on the East.

d) *Multiple routes and multiple ports of arrival.* Intermodally connected DCs allow utmost flexibility on ports of arrival selection and intermodal connection. This protects the company from possible chain interruptions due to port strikes and congestions, allows to utilize vast majority of steam ship lines and rail-roads in case of operational glitches of any kind.

e) *Various classes of transport assets contracted for deliveries execution.* Ability to cover most reliable services, different ocean vessel rotations and ports of transship. Large size Beneficial Cargo Owners (BCO) are in the position to distribute sufficient volumes directly with the carriers. Midsize and small size shippers typically operate through freight forwarders to benefit from existing basket deals.

f) *Highly manageable last mile based on several reliable contractors.* Resilient last mile has to be organized through several asset own contractors and a 3PL in order to maximize pool of possible dray agents. ELD implementation in mid Jan 2018 showed that assets own truckers can commit for the workload that exceeds bandwidth of their fleet that eventually makes them selective. So

when contractual and spot markets are inflating lower paid cargo can make the company less attractive. Typically US based truckers have high level of debt and upon cashflow gap are forced to go out of business. Keeping 3PL in the contractors' network helps to make a smooth switch when needed.

g) *Clean data for real time visibility. Outrunning indicators to trace shifts in transport capacity supply.* Understanding and acting towards quality data became the cornerstone of prompt decision making for any decent size shipper these days. US shippers work with own and 3rd party data to trace key disruption phenomena and seek for the triggers of switching from one operations flexible to another. Re-active companies with all strategical measures encounter significantly higher losses comparing to proactive.

Tactical measures:

a) *Operations planning, lead time of placing seafreight bookings and inland transport allocations have to go from standard 2 weeks to 4 weeks in advance.* Upon capacity tightening for both seafreight and drayage first step to accomplish is becoming forecast horizon increase from 2 to 4 weeks. Seafreight bookings placed 4 weeks in advance with steam ship lines significantly increase probability of prompt departure of goods from port of loading. Reasonable number of bookings 10-15% can be amended and pushed back for later departures. Shipper has to ensure that ration of cancelled bookings remains low, so trust is retained. Drayage moves along with key requirements have to be forecasted 3-4 weeks in advance upon cargo departure from Origin. Depending on projected warehouse bandwidth at time of cargo arrival special handling requirements: pre-pull, yard storage, drop/pull have to be aligned so no gaps on assets utilization occur.

b) *Blank sailings monitoring, alternate services selection.* Circumstantial blank sailings are becoming a powerful tool of balancing actual demand with capacity supply. This is fair especially for direct call strings of Transpacific Eastbound trade lane that is

being operated with the ocean vessels of medium size, up to 10-12 thousand TEU. Steam ship lines can easily remove by blanking (canceling) departures at a certain week. During Apr-May 2020 up to 30% of overall Transpacific capacity was removed (Fig 2). Typically this information is known several weeks in advance, that makes shippers to seek for alternate steam ship line option or alternate routing of cargo from the port of loading.

c) *Multiple ports and DCs are feed on a weekly/monthly basis.* When recognized

timely, capacity tightness has to be mitigated by utilizing multiple routes and ports of arrival feeding all DCs from the network. Each DC has to have a safety stock replenished on a regular basis that would allow cargo owner to be backed up in case of demand fluctuation on downstream side. Safety stock also serves possible losses and penalties from the ultimate customers in case shipments got delayed.

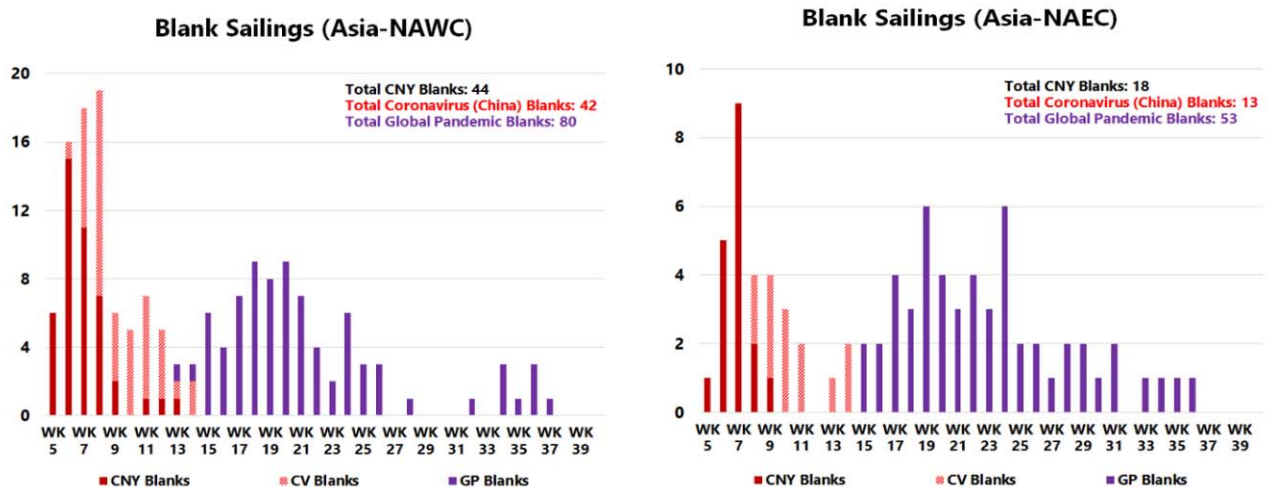


Fig. 2 Blank sailings

Source SeaIntelligence Jul 19, 2020

d) *Expedited full container load (FCL) services considered for time sensitive goods.* Shippers from automotive segment are utilizing so-called expedited FCL services for Transpacific trade lane on a systematic basis. Those yield faster transit time by 30%-45% on average and priority in port handling at origin and destination, no roll-overs at departure. They are being operationally traced in the manner that allow minimum dwell time at port and rapid connection with rail-road or release to a dray agent. These services operate smaller capacity vessels of 2-3 thousand TEU and require valid service contract and proved track record to get required space allocation at time of peak season or overall capacity tightness.

e) *Full container load (FCL) vs less than container load (LCL) transportation mode selection in conjunction with inventory stock*

replenishment requirements. Less than container load freight rates are typically less sensitive to a fluctuations and can yield sizeable cost advantages for shipments up to 12-15 cbm in measure at time of FCL market peaks. LCL containers pay higher freight amounts in general and has higher priority in handling at both departure and arrival ports. Those are still consider general shipments if not shipped through one of expedited services. Shipper can partially mitigate cost increase by streamlining some of consignments through LCL. Cargo has to be seaworthy packed to prevent damage due numerous handling operations. Overall transit time will be 14 days longer on average but increase probability of in-time departure.

f) *Containers dwell time increase at time of Trade War between US and China.* Starting early 2018 a number of proclamations have

been issued that imposed tariffs on steel and aluminum products imported from overseas as well as wide variety of goods manufactured in China. Tariffs implementation was set in phases and most impactful 301 Tariff Section was due to go into force Jan 1 2019. Shippers were advancing their cargo in order to create necessary inventory margin earlier on. Larger volumes of goods were shipped and customs cleared outrunning actual demand by 90-120 days. That means that outbound pace for distribution became considerably lower than inbound pace. Consequently this created additional loading on warehouse space projected for normal case operations. In order to understand relative impact of Tariffs imposed study of 6250 shipments from China ports into port Los Angeles has been conducted. Those were divided to containers terminated at port of arrival and containers that are being moved intermodally to the inland terminals (dry ports) by rail-road.

Dwell time is a good indicator of overall delivery chain productivity, warehouse and drayage capacity states. Increasing dwell time means that either port is congested, and

containers can't be processed timely or shipper made a conscious decision to keep arrived cargo at port until warehouse has enough space for in-storage.

For the purpose of the study dwell time (port terminal storage time) was segregated in ranges: 1-5 days, 5-10 days, 10-20 days, over 20 days. Port storage of 1-5 days can be considered as normal for the goods terminated at port towards existing business practices and actual dray operations timings for majority of US ports. Typically steam ship lines honor 5 days free at port that are being used as a grace period to arrange last mile delivery. Port dwell time is the main source of hard dollar losses that cannot be mitigated operationally. 1 Day of storage outside of grace period costs USD 265/day per container. So containers that spent 5 extra days at port encounter USD 1 325 in storage fees per container, that equals 50% of seafreight charges at that time, those encounter 15 days would pay USD 3 975 per container. In Fig. 3 chart of dwell time dynamics from March through Dec is shown.

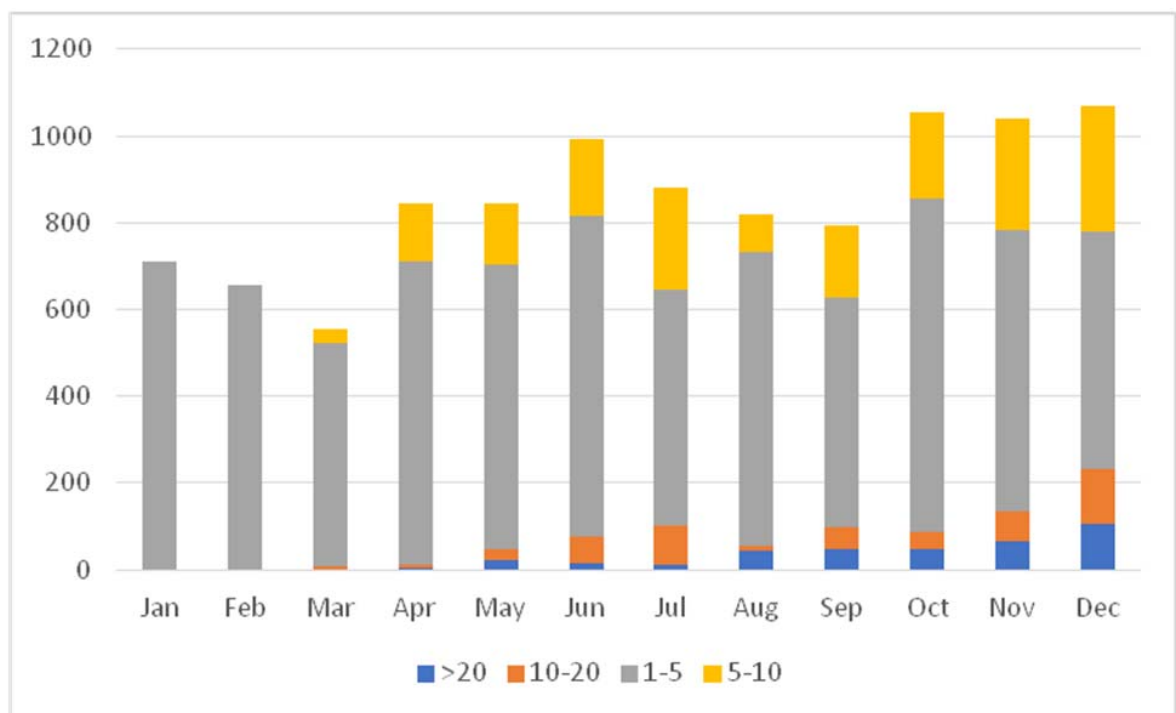


Fig. 3. Port terminated containers dwell time chart 2018

Source <https://www.oocl.com/eng/ourservices/eservices/cargotracking/Pages/cargotracking.aspx>

With normal case operations in Jan through March dwell time started to increase significantly by June. Partially this is caused by Christmas and New Year inventory being brought in and partially by seasonal cargo advances imported to outrun 301 Tariff Section. Storage periods reached their peak in

Q4 when number of containers that spent over 10 days and over 20 days were doubling in each consecutive month.

Dwell time dynamics for the containers that were moved intermodally from port of Los Angeles are shown in Fig. 4.

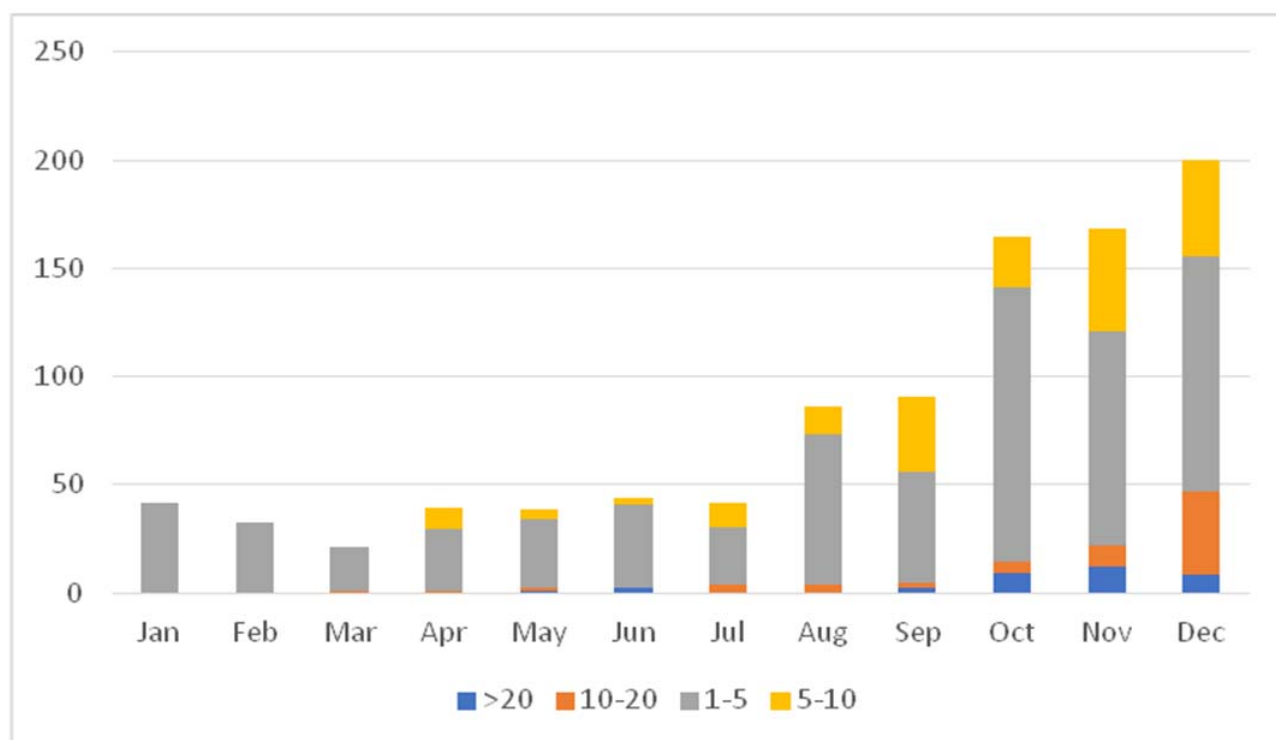


Fig. 4. Intermodally moved container dwell time

Source <https://www.oocl.com/eng/ourservices/eservices/cargotracking/Pages/cargotracking.aspx>

Comparison results of dwell time for port terminated containers vs moved intermodally is shown in Table 3.

Table 3

Dwell time comparison									
	Total	1-5 days	5-10 days	10-20 days	Over 20 days	1-5, %	5-10, %	10-20, %	Over 20, %
Port terminated	3163	1964	748	234	219	62.1	23.5	7.4	6.9
Moved intermodally	534	335	116	54	30	62.7	21.6	10.1	5.6

Source <https://www.oocl.com/eng/ourservices/eservices/cargotracking/Pages/cargotracking.aspx>

Considering comparison results show that dwell time difference is insignificant. The main fact to keep in mind that intermodally moved containers do not encounter port storage charges since based on business

practices steam ship lines remain liable for the storage charges.

Containers street dwell time, time spent by the inbound container outside port terminal is shown on Fig. 5.

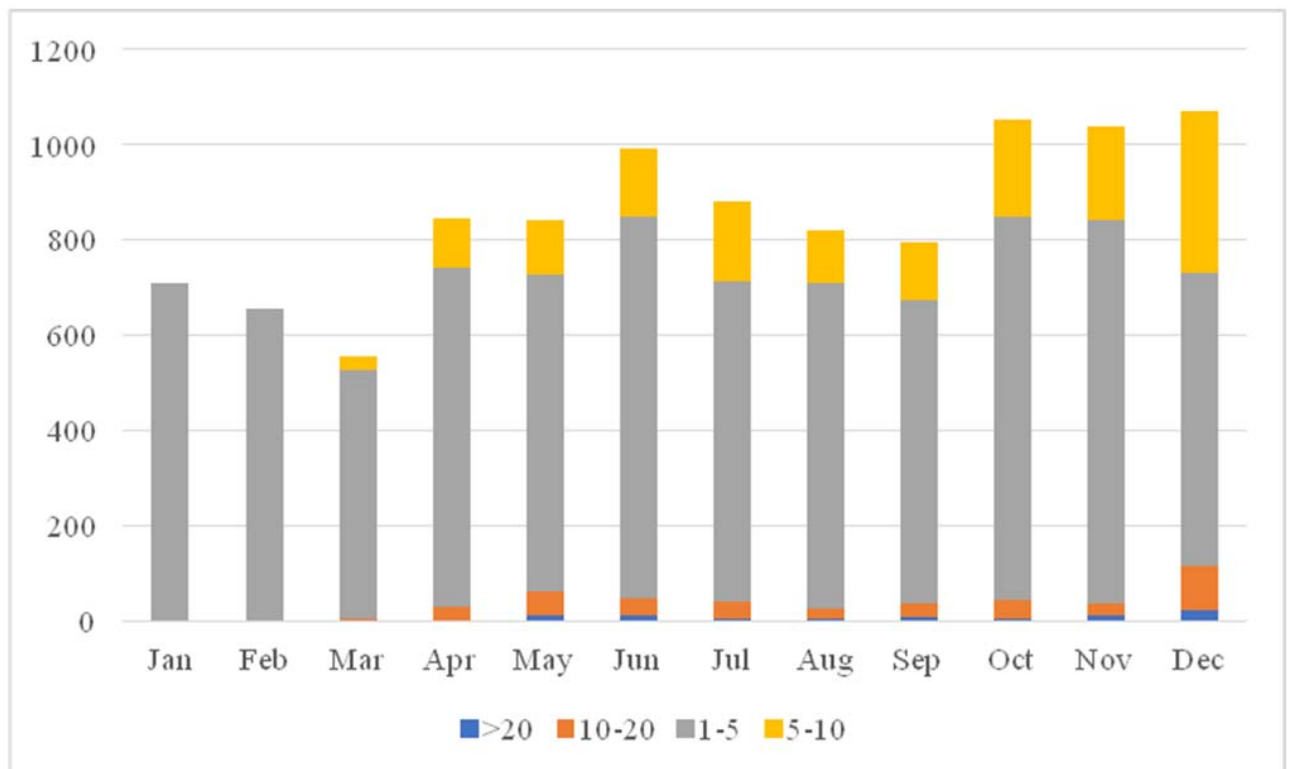


Fig. 5. Street dwell time outside of Los Angeles port

Source <https://www.oocl.com/eng/ourservices/eservices/cargotracking/Pages/cargotracking.aspx>

In Q4 2018 warehouse space in Los Angeles area became exhausted and inbound container flows were exceeding outbound port terminated container. Containers quantity that required extended dwell time of over 10 days went from average 33 in Oct and Nov to 93 in Dec, those quantity that were hit by 20 days outside the port increased twice from 10 in Nov to 21 in Dec.

A detailed description of ways to reduce the risks when shipping cargo to the United States is described in [15]. In particular, it was noted that the organization of a stable and reliable system of supplying products on time within the allotted budget plays a leading role.

Conclusions. In the article detailed study of the strategic, long-term and tactical, short-term planning carried out by US shippers was presented. Strategic and tactical measures to increase the sustainability of the supply chain were identified. The relative impact of tariffs imposed was analyzed through the case study of 6250 shipments from Chinese ports into Los Angeles port.

Majority of the studies that have been conducted by the time being are often based on the assumptions that foreign supply is unlimited or that inventory stock at destination can be increased to the level that prevents unfulfilled domestic orders. Reality is different though. Supply at origin is rare to be unlimited. Typically purchase orders size increase is caused by uncertainty factors or scares financial recourses that didn't allow to retain production and supply pace. There are many business cases when vendors overseas can recognize destination market developments and increase goods prices, increase lead times or request advance payments to prioritize and satisfy additional demand. This might also create some lag that will be required to negotiate acceptable conditions, so naturally time between minimum stock inventory achieved and goods shipped will be significant. Safety inventory might be of help, but market environment change can create inventory imbalance by populating the shortage for the most demanded goods. Having said that main potential of the further research is:

- elaboration of the system of outrunning indicators that would help the shipper to recognized emerging trends that could lead to a disruption or at least significantly increase supply chain vulnerability

- assessment of digital technology and real time visibility tools to increase operations and transport capacities planning in order to partially mitigate losses at time of supply chain disruption.

References

1. Mota, B., Gomes, M.I., Carvalho, A., Barbosa-Povoa, A.P. (2018). Sustainable supply chains: 2. An integrated modeling approach under uncertainty. *Omega*, 77, 32-57.
2. Lee, H., Gillai, B., Chen, Y., Rammohan, S. (2016). U.S.-to-China B2C E-commerce: Improving Logistics to Grow Trade. Stanford Value Chain Innovation Initiative. Retrieved from: <https://public2-stage.gsb.stanford.edu/sites/gsb/files/publication-pdf/vcii-white-paper-us-china-ecommerce-imrpove-logistics-grow-trade.pdf>
3. Lee, H.L., Shen, Z.-J. (M.) (2020). Supply chain and logistics innovations with the Belt and Road Initiative. *Journal of Management Science and Engineering*. Retrieved from: <https://doi.org/10.1016/j.jmse.2020.05.001>
4. Munir, M., Jajja, M.Sh.S., Chatha, K.A., Farooq S. (2020). Supply chain risk management and operational performance: The enabling role of supply chain integration. *International Journal of Production Economics*, 227, 107667. Retrieved from: <https://www.sciencedirect.com/science/article/abs/pii/S092552732030061X#!>
5. Xu, M., Cui, Y., Hu, M., Xu, X., Zhang, Z., Liang, S., Qu, S. (2019). Supply chain sustainability risk and assessment. *Journal of Cleaner Production*, 225, 857-867.
6. Hossain, N.U.I., Amrani, S.E., Jaradat, R., Marufuzzaman, M., Buchanan, R., Rinaudo, C., Hamilton, M. (2020). Modeling and assessing interdependencies between critical infrastructures using Bayesian network: A case study of inland waterway port and surrounding supply chain network. *Reliability Engineering & System Safety*, 198, 106898. Retrieved from: <https://www.sciencedirect.com/science/article/abs/pii/S0951832019307562>
7. Oh, H., Lee, S.-W., Seo, Y.-J. (2018). The evaluation of seaport sustainability: The case of South Korea. *Ocean & Coastal Management*, 161, 50-56.
8. Baert, L., Reynaerts, J. (2020). An examination of the determinants of inter-port competition for U.S. imports. *Case Studies on Transport Policy*, 8(2), 281-292.
9. Wan, S., Luan, W., Ma, Y., Haralambides, H. (2020). On determining the hinterlands of China's foreign trade container ports. *Journal of Transport Geography*, 85, 102725. Retrieved from: <https://www.sciencedirect.com/science/article/abs/pii/S0966692319308518>
10. Han, C.-H. (2018). Assessing the Impacts of Port Supply Chain Integration on Port Performance. *The Asian Journal of Shipping and Logistics*, 34(2), 129-135.
11. Ascencio, L.M., González-Ramírez, R.G., Bearzotti, L.A., Smith, N.R., Camacho-Vallejo, J.F. (2014). A Collaborative Supply Chain Management System for a Maritime Port Logistics Chain. *Journal of Applied Research and Technology*, 12, 444-458.
12. Moros-Daza, A., Solano, N.C., Amaya, R., Paternina, C. (2018). A multivariate analysis for the creation of Port Community System approaches. *Transportation Research Procedia*, 30, 127-136.

13. Notteboom, T., Van der Lugt, L., Van Saase, N., Sel, S., Neyens, K. (2020). The Role of Seaports in Green Supply Chain Management: Initiatives, Attitudes, and Perspectives in Rotterdam, Antwerp, North Sea Port, and Zeebrugge. *Sustainability*, 12, 1688. Retrieved from: DOI:10.3390/su12041688
14. Jiang, B., Li, J., Shen, S. (2018). Supply Chain Risk Assessment and Control of Port Enterprises: Qingdao port as case study. *The Asian Journal of Shipping and Logistics*, 34 (3), 198-208.
15. Patkovskiy S. Overseas. How and for how much to organize export deliveries to the US. *Za okean. Yak i za skil'ky organizuvaty eksportni postavky v US. Business*. Retrieved from: <https://nv.ua/ukr/biz/experts/postavki-tovariv-v-ssha-skilki-koshtuyut-i-yak-ne-zaplatiti-shtraf-50091444.html>

UDC 338:45:658.8:621.3

DOI: <https://doi.org/10.46783/smart-scm/2020-2-5>

JEL Classification: L25, M21.

Received: 30 July 2020

Popovychenko I.V. Doctor of Economic, Professor, Head of Economics and Entrepreneurship Department State Higher Educational Establishment "Prydniprov's'ka State Academy of Civil Engineering and Architecture", Dnipro, (Ukraine)

ORCID – 0000-0003-3443-9356

Researcher ID – Q-7739-2017

Scopus author id: –

Spiridonova K.O. PhD (Economics), Associate Professor, Associate Professor of Economics and Entrepreneurship Department State Higher Educational Establishment "Prydniprov's'ka State Academy of Civil Engineering and Architecture", Dnipro, (Ukraine)

ORCID – 0000-0001-6961-4172

Researcher ID –

Scopus author id: –

APPLICATION OF FUNCTION COST ANALYSIS AND NETWORK SCHEDULING IN LOGISTICS COST MANAGEMENT

Iryna Popovychenko, Kira Spiridonova "Application of function cost analysis and network scheduling in logistics cost management". Dynamic nature of logistic costs as well as dynamic and complicated modern economic environment urges scientists to seek new and improve existing forms and approaches to identification, accounting and management of companies' logistic costs and supply chains. Adaptation of logistic cost management to modern challenges is important. Business competitiveness nowadays depends on fast and exact reaction of business management on unpredictable, changing and risky micro- and macro environment. Clear and available technologies of influence on profitability of economic activity due to rational decreasing and optimization of expenses become more and more demanded on Ukrainian and world markets. Rational planning and minimization of logistic costs of operational activity of production and commercial companies is great potential reserve and powerful tool on the competitive space if used by experienced specialists.

In the article it is proposed to combine powerful methods - function cost analysis and network planning on the basis of process, project and logistics management using simplified example. As a result, the client's demands concerning shortening terms of the order with optimal cost and quality of service for both or more sides are fulfilled. At the meantime the riskiest sites of supply chain are determined that allows to predict and avoid possible problems.

The material needs further specification, economic and mathematical modelling, and professional discussion by specialists in management of supply chains, operational managers, IT-specialists, as supply chains are complicated open and flexible systems.

Keywords: logistics costs, operational activity, supply chains, function cost analysis, network planning, time factor.

Ірина Поповиченко, Кіра Спірідонова «Застосування логіки функціонально-вартісного аналізу та календарно-сітьового планування в управлінні логістичними витратами». Динамічність природи логістичних витрат у поєднанні із динамічністю та складністю сучасного економічного середовища спонукає науковців та фахівців-практиків до пошуку нових та вдосконалення існуючих форм та підходів до ідентифікації, обліку й управління логістичними витратами підприємств та ланцюгів постачань. Важливою є адаптація процесів управління логістичними витратами до викликів сьогодення. Конкурентоспроможність бізнесу сьогодні залежить від швидкості та точності реакції менеджменту підприємств та організацій на непередбаченість, мінливість, ризики макро та мікро середовища. Прозорі та доступні технології впливу на прибутковість господарської діяльності через раціональне зменшення та оптимізацію витрат стають сьогодні все більш затребуваними на українському та світових ринках. Раціональне планування та розумна мінімізація логістичних витрат, що супроводжують операційну діяльність виробничих та комерційних підприємств, є великим резервом, наразі більшою мірою потенційним, та потужним знаряддям на конкурентному просторі у руках досвідчених професіоналів.

У статті на ідеологічному підґрунті процесного, проектного та логістичного менеджменту на спрощеному практичному прикладі пропонується поєднання потужних методів – функціонально-вартісного аналізу та календарно-сітьового планування, в результаті чого виконуються вимоги клієнта щодо скорочення термінів виконання замовлення при оптимальній для обох чи більше сторін вартості та якості послуги. При цьому проявляються найбільш ризиковані ділянки ланцюга постачання, що дозволяє передбачити можливі проблеми та запобігти ним.

Представлені розробки, безумовно, потребують подальшої деталізації, економіко-математичного моделювання та фахового обговорення у колі фахівців з управління ланцюгами постачання, операційних менеджерів, IT-спеціалістів, оскільки ланцюги постачань – це надскладні відкриті та гнучкі системи.

Ключові слова: логістичні витрати, операційна діяльність, ланцюги постачань, функціонально-вартісний аналіз, календарно-сітьове планування, фактор часу.

Ірина Поповиченко, Кіра Спіридонова «Применение логики функционально-стоимостного анализа и календарно-сетевого планирования в управлении логистическими затратами». Динамичность природы логистических затрат в сочетании с динамичностью и сложностью современной экономической среды побуждает ученых и специалистов-практиков к поиску новых и совершенствование существующих форм и подходов к идентификации, учета и управления логистическими затратами предприятий в цепях поставок. Важна адаптация процессов управления логистическими затратами к вызовам современности. Конкурентоспособность бизнеса сегодня зависит от скорости и точности реакции менеджмента предприятий и организаций на непредсказуемость, изменчивость, риски макро и микросреды. Прозрачные и доступные технологии влияния на прибыльность хозяйственной деятельности за рациональное уменьшение и оптимизацию расходов становятся сегодня все более востребованными на украинском и мировых рынках. Рациональное планирование и умная минимизация логистических издержек, сопровождающих операционную деятельность производственных и коммерческих предприятий, является большим резервом, пока в большей степени потенциальным, и мощным орудием в конкурентном пространстве в руках опытных профессионалов.

В статье на идеологической основе процессного, проектных и логистического менеджмента на упрощенном практическом примере предлагается сочетание мощных методов - функционально-стоимостного анализа и календарно-сетевого планирования, в результате чего выполняются требования клиента по сокращению сроков выполнения заказа при оптимальной для обеих или более сторон стоимости и качества услуги. При этом проявляются наиболее рискованные участки цепи снабжения, позволяет предвидеть возможные проблемы и предотвратить их.

Представленные разработки, безусловно, нуждаются в дальнейшей детализации, экономико-математического моделирования и профессионального обсуждения в кругу специалистов по

управлению цепочками поставок, операционных менеджеров, IT-специалистов, поскольку цепи поставок - это сложнейшие открытые и гибкие системы.

Ключевые слова: логистические расходы, операционная деятельность, цепь поставок, функционально-стоимостной анализ, календарно-сетевое планирование, фактор времени.

Introduction. The problem of accounting and analysis of the sources of logistic costs formation and management is of great importance nowadays and is examined by variety of scientists and specialists due to some reasons:

- dynamism (flow and not static nature) of logistics costs in logistical system as an object of control is a more complicated substance than an enterprise. So the chain 'supplier-enterprise-consumer' is the logistical system. It is obvious that it makes regional, national and macrologistical systems aiming to be effective and as a result competitive. In its turn business effectiveness is highly dependent on incomes and expenses that are generated with logistical activity providing operational activity of company's / companies'- participants of the supply chain;

- It is difficult to determine logistics and transaction costs centres as they are related to different functional structural departments. Even if the centers of logistic costs are identified and all logistic costs from different centers are aggregated and accumulated, eventually this aggregated value in fact does not often coincide with arithmetical sum of the certain costs in specific departments (centres). It is considerably connected with classical disadvantages of enterprise's functional organization structure, i.e. disadvantages of functional specialization. This happens because some considerable logistic and transactional costs remain unnoticed, not identified and/or standardized in cross-functional relations with suppliers and customers, as it is not possible to determine clearly what functional department is responsible for them (for example, purchasing or transportation department, sales department or finished products warehouse). However, if these

expenses are neither noticed nor accounted it doesn't mean that they don't decrease the company's profit. It is difficult to determine who is responsible for these turnover costs in the chain 'purchase-production-sales'. As a result, it is difficult to control, regulate and manage them in time and space.

- Normative documents of state authority and service concerning cost accounting do not include methods of cost identification connected with logistic processes. There are neither clear criteria of cost allocation to some account nor the order of current logistic cost reflection.

Thus, the problem of accounting and management of logistic costs is connected with developing approaches to rational separation of information concerning logistic costs from the company's information flows. This problem, beginning with definition and classification of logistic costs is investigated in works of Sumets O.M. [1,2], Krykavskyy, E.V. [3], Mirotin L.B., Tashbaev E. [4], Oklander M. A. [5], Reta M.V. [6], Yatsenko G. [7], James R. Stock, Douglas M. Lambert [8] and others. The authors Zavitiy O., Didorenko T., Kondratyuk L. [9] investigated logistic costs of production enterprises as objects of accounting and control. Scientific analysis concerning composition and grouping of logistical costs were carried on, specific aspects of logistic costs in enterprise's accounting and control were determined. The authors Minko K.M., Korotuha K.M. presented the general definition: 'Logistic costs management is a process of making logistic decisions based on the data of total costs accounting of material, informational and financial flows management in the whole logistic system in order to achieve decreasing of logistic activity costs' [10]. However, dynamic nature of logistic costs as well as dynamic and complicated modern economic environment

urges scientists and specialists to seek and implement new forms and approaches to logistic costs identification, accounting and management.

The purpose and tasks of the research.

In order to improve accounting of logistic operations and costs as well as management of these expenses it is necessary to create an adequate system of management accounting and controlling within a company allowing to receive information for analysis, taking and realization of managerial decisions concerning logistic costs. In our opinion, it is possible to evaluate effective and control logistic costs effectively on the basis of the concept and technology of process management, in particular using functional cost analysis. If one combines process management with project approach and effective logistic management, it will lead to increasing of the company's competitiveness (excluding force majeure).

Therefore, the purpose of this research is analysis of possibilities and feasibility of functional cost analysis usage combining method of network scheduling for optimization of logistic costs in supply chains considering time factor.

Tasks of the research: to show on the simple example the process of organization, tracking and regulation of logistic business-processes that are viewed as a sequence of interconnected operations in time and space with criteria of effectiveness – minimum of total costs on the client's order within the given level of quality and time. Instrument that is proposed in order to fulfil the task is function cost analysis combining with network planning.

The main material and results. Having made analysis of popular cost management methods concerning logistic costs (Absorption costing, Direct costing, Standard costing, Target costing, Kaizen costing) we came to the conclusion that none of the approaches can be considered a universal one for all enterprises as they don't allow to assess logistic costs as a dynamic category with changing value [2,11]. Realizing significance

and advantages of these methods, let us try to view the primary elementary level of logistic costs formation and control with the help of combined usage of function cost analysis concept and network planning instrument considering logistic management.

It is known that function cost analysis (FCA) or analysis of function (or operation making the process) cost appeared as a method of production effectiveness increasing based on finding reserves and cost decreasing in technological processes on life cycle stages of a product (pre-production, production, operational and utilization). So function cost analysis is a complex research of objects functions (product, process, structure), aiming at optimization of quality functions and expenses.

In her scientific and practical works Melnikova K.V. reviews function cost analysis as a financial instrument in strategic management of logistic costs that allows to decrease production and service costs and increase level of their quality. Function cost analysis is a way to decrease level of logistic costs as during the analysis separate stages of the process (operation) of customer's orders are carefully examined, possibilities of their standardization and making service process less expensive are considered [12, p. 34-36].

In order to use function cost analysis, it is necessary to describe business processes of the company as a part of its business activity. Having made the correspondence between each function and its cost it is possible to fulfil the following kinds of analysis:

- research of cost distribution with their functions (operations) as well as determination of the most expensive functions (operations) in order to improve them firstly;
- determination of functional directions (operations) that should be fulfilled independently or use service of outsourcers or combine both in a certain proportion;
- cost modelling of business processes determining structure (architecture) of business process with the most optimal cost.

One more important criterion that characterizes function (operation) or business-process, except value, is time of the (function) operation or the whole business-process. For example, if the shipment time in one company is 10-20% more than in the company of their competitor, the company can lose its market share very quickly if their products and services don't have other competitive advantages: price, payment terms, quality, service, after-sales service. As a result, function cost analysis along with time costs study significantly broadens possibilities of the method. In general case during function cost analysis time and value expenses are used simultaneously and they are interconnected in most cases. As a result of function cost analysis optimal structure of the business process with optimal parameters of time and value is developed. Strategic goals of the company determine optimal or desired parameters.

Organization of logistic business processes is considered as sequence of the certain interconnected operations fulfilled in time and space, so function cost analysis for taking logistic decisions should be viewed along with methods of network scheduling used in project management. Criterion of effectiveness is minimum of total expenses for the client's certain order at the given level of quality and abundance by given time frames.

Therefore, we should recollect the main idea of network planning as a method of project management. A project in wide understanding is any task that should be realized in the given term, within determined budget and with expected level of quality. It is obvious that there are three out of six well-known rules of logistics (time, costs, quality) in this definition. These are key characteristics of effective organization of logistic process.

Network planning allows to combine time management, cost management and management of resources while solving any task or project dividing them on elemental components. Its methods have such well-known international names and abbreviations as CPM (Critical path method),

CPA (Critical path analysis) or PERT (Program evaluation and review technique). It is possible to:

- determine and present full volume of works – logistic operations as charts;
- determine clear and achievable goals concerning time of works – logistic operations, their cost and necessary resources;
- assess the budget (value) of task (order) fulfilment;
- monitor and control fulfilment of work (logistic operations) and predict the further course of events;
- delegate responsibility among participants of logistic process and/or employees of the company's logistic department effectively;
- redistribute resources, decrease risks and uncertainty based on determination of critical work (logistic operations). In project management critical work means operations without reserve of time for its fulfilment. So it is impossible to change its beginning and end (for example due to technological reasons or other limitations).

Network planning means creating logic diagrams of sequence of project works (operations) fulfilment – network chart and determination of duration of these works (operations) and the project in general with the purpose of further control.

Using network planning helps to answer the following questions [13]:

1. How much time does it take to complete certain operations and the whole project (or the certain order)?
2. What time is it necessary to begin and finish some works and operations?
3. What works-operations are 'critical' and must be fulfilled as scheduled in order to meet deadlines of the project (or the order) in general?
4. What term is it possible to postpone fulfilment of 'non-critical' works in order not to impact the terms of the project (the order)?

Network schedule presents sequence and interconnection of works-operations of the project. In order to develop it one should

have such information: list of operations, time of operations fulfilment, logical connections among them. Then linking the chart received to the schedule, we have the exact final date of the order / project fulfilment convenient for both sides - customer and contractor, complying with the terms of the price, quality of the service and possible risks. Logical links among works (operations) can be basically of two types:

- consistent when the next work (operation) is fulfilled after the previous one;
- parallel when several works (operations) can be fulfilled simultaneously.

There are also requirements concerning simultaneous beginning and end of several operations that can be caused by technological or other subjective or objective factors.

Below we give an example of network planning usage admitting that there is information about composition and

architecture of some business processes and operations. Minimum possible and normal duration and value of these operations fulfilment is also known. In the table 1 there is information about logistic provision of the order fulfilment concerning purchase and delivery of loads from two foreign countries for one customer in Kyiv. It is necessary:

- a) to make Work Breakdown Structure (WBS) and network schedule of the order determining critical operations;
- b) to analyze opportunities of speeding of the order fulfilment for two days with minimum expenses using additional information from table 2.

Work (operation) can be determined as an action necessary for realization of a project (order). In network schedules works and operations have their number or code as to Work Breakdown Structure. WBS is the sequent breakdown of a project (task) to subprojects (subtasks), work packages of different level, exact operations.

Table 1.

Logistic support of the order – purchase and delivery of loads 'X' and 'Y' for the customer 'Z' from Ankara (Turkey), Berlin (Germany) to Kyiv (Ukraine)

Operation code	Operation	Previous operation	Duration (days)
<i>A</i>	Making an agreement on the load delivery 'X' from Turkey.	—	3
<i>B</i>	Transportation of load 'X' from Ankara to Kyiv by two means of transport with customs clearance in Odesa port	<i>A</i>	7
<i>C</i>	Making an agreement on the load delivery 'Y' from Germany.	—	3
<i>D</i>	Transportation of load 'Y' from Berlin to Kyiv by one means of transport with customs clearance in Rava-Ruska	<i>C</i>	6
<i>E</i>	Placement of loads 'X' and 'Y' on cross-docking storage in distribution center in Kyiv.	<i>B, D</i>	2

Table 2.

Characteristic of logistic operations terms and expenses on their fulfilment under scenarios of normal and minimum possible duration of such operations

Operation code	Duration of the operation, days		Costs, (y.o.)		Maximum shortening of duration, days (2)-(3)	Unit expenses on reduction of operation duration, conventional units/day $[(5)-(4)] / (6)$
	normal	minimum	Normal duration	Shortened duration		
1	2	3	4	5	6	7
A	3	2	400	700	1	300
B	7	4	1000	1600	3	200
C	3	1	400	1000	2	300
D	6	4	1000	1800	2	400
E	2	1	600	1100	1	500
Total			3400	6200	—	

Solution

A) Let us present WBS-structure of this order (№1) on Figure 1.

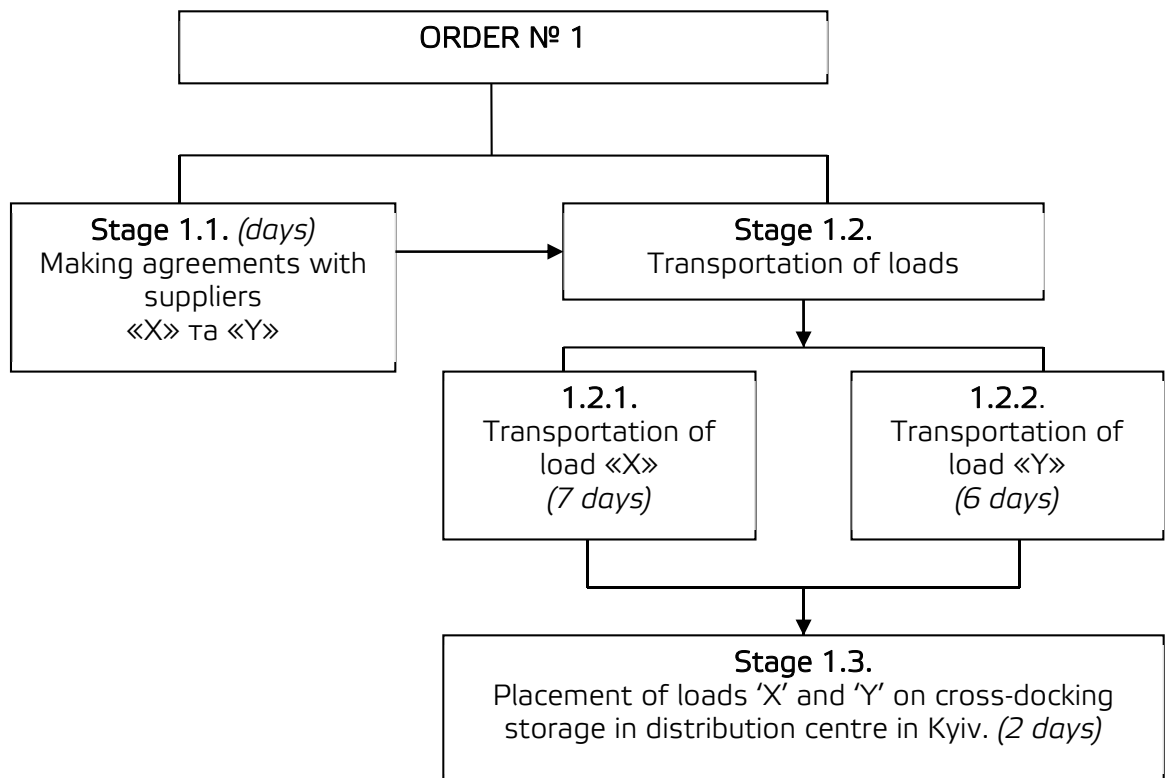


Figure 1 - WBS-structure of the order – purchase and delivery of loads 'X' and 'Y' from Turkey (Ankarra) and Germany (Berlin) to Kyiv

B) Let us make network schedule of this order using sector method (figure 2).

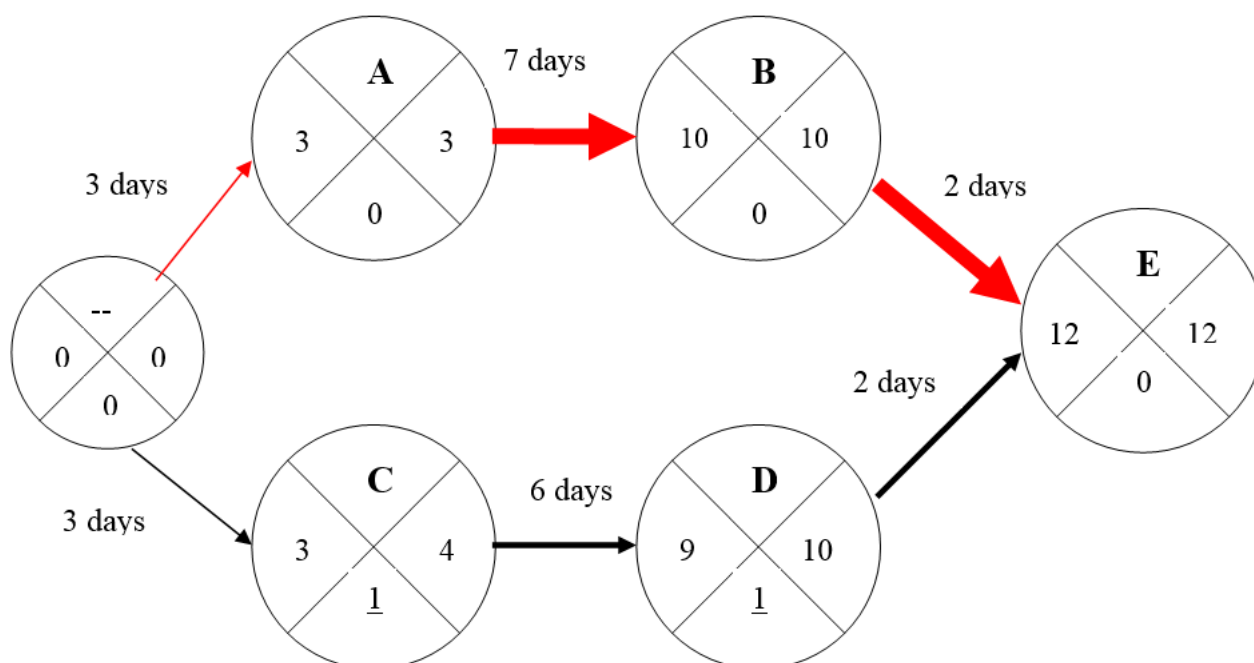


Figure 2 – Network schedule of order №1

Explanations to figure 2 (on the example of operation D) is presented on figure 3.

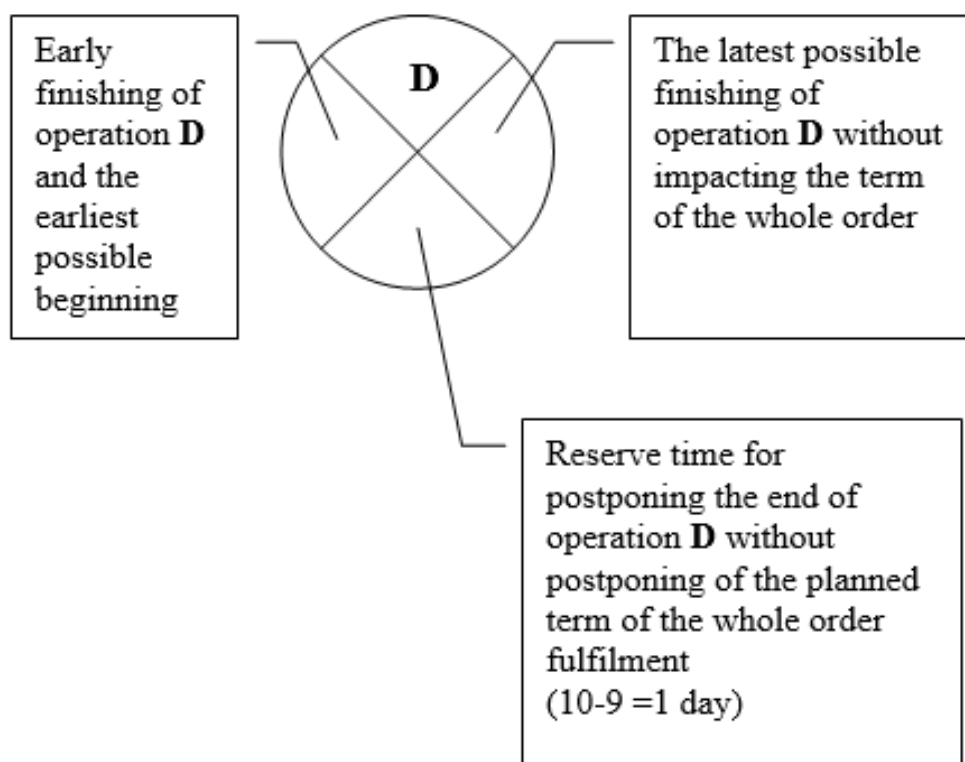


Figure 3 - Explanations to picture 2 (on the example of operation D)

As a result of estimation of network parameters of the order fulfilment with sector method there are three critical operations (critical paths) A, B, E. These operations have no time reserve and we cannot change the terms of their beginning and the end without impacting the term of finishing the task in general. (We see the same value in the right and left sectors of these operations and zero-time reserve written at the bottom sector of these operations).

However, there is a question – what to do if our client is not satisfied with the term of the order fulfilment of 12 days and he wants to receive his load not later than in 10 days?

In this case there is a necessity of shortening the term of some operations to provide the planned term of the order fulfilment. This procedure is also called optimization of the network schedule.

Manager-logistician in general can use such methods of shortening operations duration:

1) redistribution of resources from non-critical to critical operations (in order to shorten the term of their fulfilment) within extra time;

2) changing logistic links among operations where possible – parallel instead of consistent ones;

3) new estimation of operations duration with critical path (as more information becomes available);

4) changing operation mode (six or seven-day work week instead of five-day one). However, it is necessary to consider decrease of labour productivity and increase of labour costs;

5) if inner resources are overloaded, one should use subcontractors, outsourcers or temporary workers;

6) changing means of transportation if using a certain kind of transport causes delay: planes instead of ships or trains;

7) technical changes that decrease duration of the work fulfilment and simplify its content (other routes, way of doing);

8) improvement of working conditions, motivation, material stimulation – bonus for shortening of operations duration (if possible);

9) increasing of qualification level that increases effectiveness of the work performed;

10) if the main criteria are time and expenses, decreasing of volume and/or labour intensity of operations, for example due to effective automation and mechanization of certain logistic operations.

The most appropriate ways for solving this task are numbers 1, 5-7, 9,10 from the general list of possible ways given above. Usually all these ways demand increasing of recourses (using additional workers or overtime) leading to increasing of expenses. That is why a manager-logistician should every time seek for the compromise between shortening of time of operation fulfilment and economy of additional expenses on completing the order in the shortest terms. He should also consider 'behaviour' of different expenses: direct variable costs that make up to 80% of all costs on the order increase when duration of operation shortens (one should use more workers, equipment, etc.). Fixed overhead costs (rent, depreciation changes, etc.) decrease.

As it is shown on picture 4, it is possible to find such a duration of the order that allows to minimize total costs necessary to complete planned operations. However, if time is the priority and the main task is to shorten duration of the initial network schedule, there is a necessity to shorten duration at the expense of increasing costs.

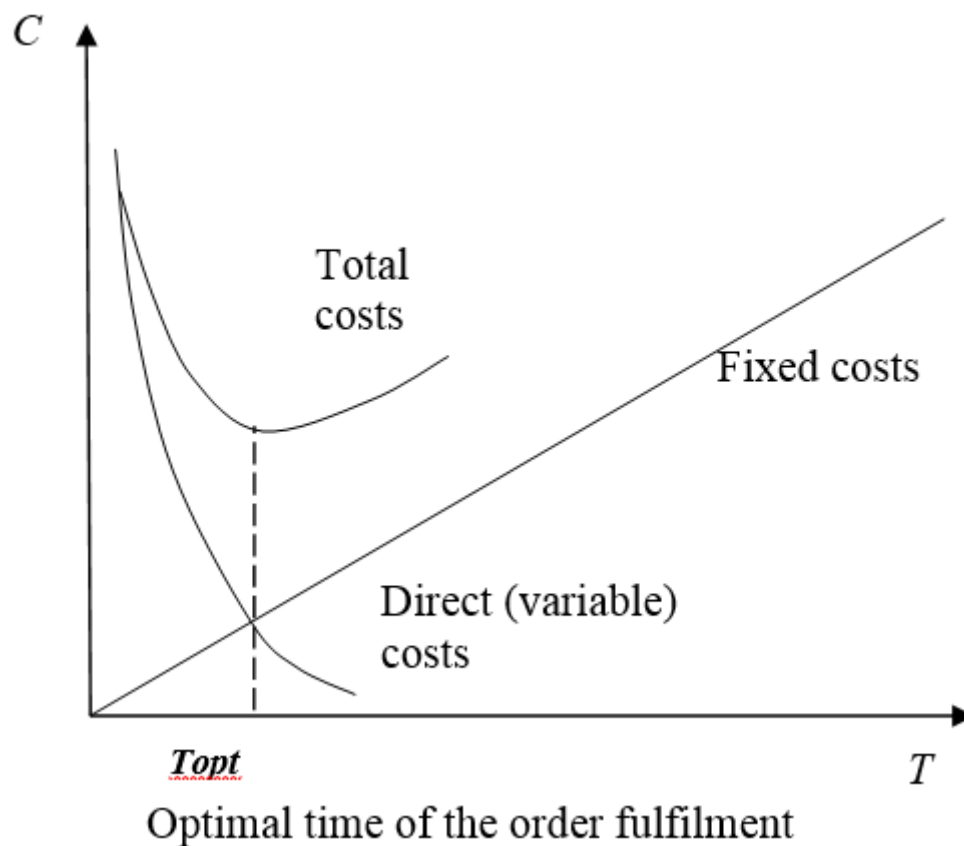


Figure 4 Graphs of total costs of the order

In our example the client insists on the order to be completed during 10 days. This can be provided with shortening of duration of some operations. So it is necessary to determine what operations (works) should be shortened and to what extent. As a result, one needs information about the possible duration of each operation and additional costs necessary for this. Manager-logician must determine:

- 1) estimated costs of operations during their normal or expected fulfilment;
- 2) duration of operations provided that they are decreased at the expense of additional recourses (minimum possible duration of operation);
- 3) estimated costs of operations at the expense of maximum shortening of their time.

Let us turn to table 2 (columns 2-5) with the necessary information for further calculations and necessary calculations in columns 6, 7.

In order to make further steps towards shortening of work duration for our order let us make an assumption about proportion: any additional share of shortening the time of operation fulfilment demands the same share of additional costs.

For example, in order to shorten operation B for 1.5 days (not 3 days), additional costs will be 200 conventional units $\times 1,5 = 300$ conventional units.

Information about cost per unit on shortening of works (column 7 table 2) leads to the question: duration of what works should be shortened? It is obvious that the specialist taking the decision has the alternatives of shortening duration of certain operations:

- 1) he can shorten duration of non-critical operations that will lead to increasing of costs, however will have no influence on the duration of the whole order;
- 2) shortening of terms of critical operations fulfilment that will influence on the decreasing of the order duration in

general and lead to increasing of costs up to limited level, because new critical paths can occur;

3) shortening of all works within old and new critical paths to achieve new desirable duration of the order fulfilment.

It is clear that one should calculate a lot of variants using special computer programs or mathematical programming, especially when there are plenty of operations and well-developed supply chain. However, in any case such a principal algorithm of shortening duration of the operation remains valid:

1. To determine critical path.
2. To determine operations to be shortened within the critical path.
3. To determine the priority of shortening terms of operations fulfilment:
 - a) operations with the lowest costs per day (time unit);
 - b) operations with the easiest possible way to shorten duration;
 - c) operations with the most effective influence on the term of the order fulfilment.
4. to shorten operations duration on one day and observe whether the new critical path will occur.

Concerning the given example shortening duration of the order demand first of all shortening duration of operation B as it is a critical one with the lowest unit expenses on the shortening (table 2). However, as to point 4 of the algorithm given above, shortening of operation B on one day creates a new critical path with operations C and D within. Continuing these actions, it turns out that the final and the most economic variant of shortening duration of the order up to 10 days will be shortening duration of operation B on two days with additional expenses of 400 conventional units and operations C or A on

one day with additional expenses of 300 conventional units.

Thus, the new duration of the order fulfilment during 10 day will cost the company additional 700 conventional units.

The method of network planning presented above allows to use the calculation within the calendar and determine the starting and the final date (deadline) of the order fulfilment and consider working time schedule.

Conclusions. It is obvious that companies' and business competitiveness directly depends on successful effective synergistic interconnection of the company with suppliers, contractors, investors, companies of related industries, service and transport structures. Therefore, raising of market competition increases improvement of logistic mechanism of economic activity for Ukrainian enterprises. Main principles of logistics are the basis for complex mechanism of effective logistic management for companies and supply chains. Both scientific and practical result of this article are presented on the simple example suggestions concerning identification, planning, control and regulation of logistic costs caused with operational business processes in chain supply. The advantage of these proposals is considering time factor while determination of logistic costs at the expense of symbiosis of principles of function cost analysis, time management, cost management of works in project management based on logistic concept of economic activity. The material needs further specification, economic and mathematical modelling, digitalization for complex systems particularly supply chains. These are perspectives for further research.

References

1. Sumets O. M. Rekomendatsii shchodo zaprovadzhennia syntetychnoho obliku lohystychnykh vytrat na pidpriumstvi. Lohystyka: problemy y reshenia. Kharkiv, 2011. № 4(35). S. 42 – 47.

2. Sumets O. M. Lohistychni vytraty pidpriemstva: teoretychnyi aspekt: monohrafiia. Kharkiv: Kharkivskiy natsionalnyi tekhnichnyi universytet silskoho hospodarstva im. Petra Vasylenka, Miska drukarnia, 2013. 223 s.
3. Vaselevskiy M, Bilyk I., Deineha O. ta in. Ekonomika lohistychnykh system: monohrafiia / za nauk. red. Ye. Krykavskoho, S. Kubiva. Lviv: Vydavnytstvo Natsionalnoho universytetu «Lvivska politekhnika», 2012. 596 s.
4. Mirotin L. B., Tashibaev Je. Logistika dlja predprinimatelja: osnovnye ponjatija, opredelenija, polozhenija i procedury: uch. posobie. M.: INFRA-M, 2002. 252 s.
5. Oklander M. A. Lohistyka: Pidruchnyk. Kyiv: Tsentr uchbovoi literatury, 2008. 346 s.
6. Reta M. V. Lohistychni vytraty: vyznachennia, klasyfikatsiia ta oblik. Biznesinform, 2012. № 8. S. 155-158.
7. Jacenko G. Ne sovsem ochevidnye njuansy porozhdajut bol'shie problemy s tolkovaniem termina «logisticheskie zhatry». Logistika: problemy i reshenija. Harkiv, 2011. № 3. S. 66 – 67.
8. Dzhejms R. Stok, Duglas M. Lambert. Strategicheskoe upravlenie logistikoj. M.: INFRA-M, 2005. 828 s.
9. Zavytii O., Didorenko T., Kondriuk L. Lohistychni vytraty vyrobnychykh pidpriemstv yak ob'iekty obliku ta kontroliu. Kontrol ta analiz v umovakh hlobalizatsii. Instytut bukhholderskoho obliku, 2019. Vyp.1-2. S. 49-73
10. Mynko L. M., Korotukha K. M. Metody upravlinnia lohistychnymy vytratamy. Efektyvna ekonomika. 2016. № 1. URL: http://nbuv.gov.ua/UJRN/efek_2016_1_41.pdf. (data zvernennia: 06.08.2020).
11. Tankov K. M. Vyrobnycha lohistryka: navch. posib. dlja stud. vyshch. navch. zakl. Kharkivskiy derzh. ekonomichnyi un-t. Kharkiv: VD "INZhEK", 2004. 352 s.
12. Melnykova K. V. Finansovi potoky v lohistychnykh systemakh: konspekt lektzii. Kharkiv: KhNEU im. S. Kuznetsia, 2015. 104 s.
13. Mazur I. I., Shapiro V. D., Ol'derogge N. G. Upravlenie proektami: Uchebnoe posobie. M.: Omega-L, 2009. 664 s.
14. Ponomarenko V. S., Tankov K. M., Lepeiko T. I. Lohistychni menedzhment / za red. V. S. Ponomarenka. Kharkiv: VD «INZhEK», 2015. 440 s.
15. Wang Bo, Bugayko D.A., Grigorak M.Y. Assessment of the national economy through the application of logistics costs. Economic Thought. 2018. № 3. P. 68-82.

Список використаних джерел

1. Сумець О. М. Рекомендації щодо запровадження синтетичного обліку логістичних витрат на підприємстві. Логистика: проблемы и решения. Харків, 2011. № 4(35). С. 42 – 47.
2. Сумець О. М. Логістичні витрати підприємства: теоретичний аспект: монографія. Харків: Харківський національний технічний університет сільського господарства ім. Петра Василенка, Міська друкарня, 2013. 223 с.

3. Васелевський М, Білик І., Дейнега О. та ін. Економіка логістичних систем: монографія / за наук. ред. Є. Крикавського, С. Кубіва. Львів: Видавництво Національного університету «Львівська політехніка», 2012. 596 с.
4. Миротин Л. Б., Ташибаєв Э. Логистика для предпринимателя: основные понятия, определения, положения и процедуры: уч. пособие. М.: ИНФРА-М, 2002. 252 с.
5. Окландер М. А. Логістика: Підручник. Київ: Центр учбової літератури, 2008. 346 с.
6. Рета М. В. Логістичні витрати: визначення, класифікація та облік. Бізнесінформ, 2012. № 8. С. 155-158.
7. Яценко Г. Не совсем очевидные нюансы порождают большие проблемы с толкованием термина «логистические затраты». Логистика: проблемы и решения. Харків, 2011. № 3. С. 66 – 67.
8. Джеймс Р. Сток, Дуглас М. Ламберт. Стратегическое управление логистикой. М.: ИНФРА-М, 2005. 828 с.
9. Завитій О., Дідоренко Т., Кондрюк Л. Логістичні витрати виробничих підприємств як об'єкти обліку та контролю. Контроль та аналіз в умовах глобалізації. Інститут бухгалтерського обліку, 2019. Вип.1-2. С. 49-73
10. Минко Л. М., Коротуха К. М. Методи управління логістичними витратами. Ефективна економіка. 2016. № 1. URL: http://nbuv.gov.ua/UJRN/efek_2016_1_41.pdf. (дата звернення: 06.08.2020).
11. Таньков К. М. Виробнича логістика: навч. посіб. для студ. вищ. навч. закл. Харківський держ. економічний ун-т. Харків: ВД "ІНЖЕК", 2004. 352 с.
12. Мельникова К. В. Фінансові потоки в логістичних системах: конспект лекцій. Харків: ХНЕУ ім. С. Кузнеця, 2015. 104 с.
13. Мазур И. И., Шапиро В. Д., Ольдерогге Н. Г. Управление проектами: Учебное пособие. М.: Омега-Л, 2009. 664 с.
14. Пономаренко В. С., Таньков К. М., Лепейко Т. І. Логістичний менеджмент / за ред. В. С. Пономаренка. Харків: ВД «ІНЖЕК», 2015. 440 с.
15. Wang Bo, Bugayko D.A., Grigorak M.Y. Assessment of the national economy through the application of logistics costs. Economic Thought. 2018. № 3. P. 68-82.

UDC 656:004.738.5

DOI: <https://doi.org/10.46783/smart-scm/2020-2-6>

JEL Classification: D3, O18, O52.

Received: 30 July 2020

Kolosok V.M. Doctor of Economic, Professor, Head of the Department of Transport Management and Logistics Department Priazovsky State Technical University (Ukraine)

ORCID – 0000-0002- 6657-933X

Researcher ID – AAC-4852-2019

Scopus author id: – 8925387300

Lazarevska Yu.A. PhD student Donetsk National Technical University (Ukraine)

ORCID – 0000-0001-8318-5861

Researcher ID –

Scopus author id: –

EFFICIENCY OF DIGITAL COMMUNICATIONS IN THE LOGISTICS BUSINESS: EVALUATION INDICATORS

Valeriya Kolosok, Yulianna Lazarevska *"Efficiency of digital communications in the logistics business: evaluation indicators". The article presents the results of the analysis of communication management practice of modern logistics companies and describes the most popular and used tools of digital communications. The expediency of using different approaches to assess the effectiveness of digital communications in logistics business. The possibility of evaluating the effectiveness of sites, social networking pages, chatbots and mobile applications is substantiated. The advantages and limitations of each of these tools for use in certain business processes to increase the level of service and customer satisfaction of the logistics business are highlighted. The importance of communications in the logistics business for the effectiveness of the company with customers, in order to increase its competitiveness.*

Keywords: digital communications, communications management, logistics, business processes, efficiency

Валерія Колосок, Юліанна Лазарєвська. *«Ефективність digital комунікацій в логістичному бізнесі: показники оцінки». У статті представлено результати аналізу практики комунікаційного менеджменту сучасних логістичних компаній та схарактеризовано найбільш затребувані та використовувані інструменти digital комунікацій. Розглянуто доцільність використання різних підходів для оцінки ефективності digital комунікацій логістичного бізнесу. Для розвитку методичного підходу оцінки ефективності комунікаційного менеджменту було узагальнено інструменти digital комунікацій, систематизовано існуючі метрики оцінки комунікаційних інструментів, визначено показники KPI конкретних каналів та інструментів комунікаційного менеджменту. Обґрунтовано можливість оцінки ефективності сайтів, сторінок соціальних мереж, чат – ботів та мобільних додатків. Виокремлено переваги та обмеження кожного з цих інструментів для використання у певних бізнес процесах для підвищення рівня обслуговування та задоволеності клієнтів логістичного бізнесу. Обґрунтовано значення комунікацій у логістичному*

бізнесі для ефективності роботи компанії із клієнтами, з метою зростання її конкурентоспроможності.

Ключові слова: digital комунікації, менеджмент комунікацій, логістика, бізнес – процеси, ефективність.

Валерия Колосок, Юлианна Лазаревская. «Эффективность digital коммуникаций в логистическом бизнесе: показатели оценки». В статье представлены результаты анализа практики коммуникационного менеджмента современных логистических компаний и охарактеризованы наиболее востребованные и используемые инструменты digital коммуникаций. Рассмотрена целесообразность использования различных подходов для оценки эффективности digital коммуникаций логистического бизнеса. Для развития методического подхода оценки эффективности коммуникационного менеджмента были обобщены инструменты digital коммуникаций, систематизированы существующие метрики оценки коммуникационных инструментов, определены показатели KPI конкретных каналов и инструментов коммуникационного менеджмента. Обоснована возможность оценки эффективности сайтов, страниц социальных сетей, чат - ботов и мобильных приложений. Выделены преимущества и ограничения каждого из этих инструментов для использования в определенных бизнес процессах для повышения уровня обслуживания и удовлетворенности клиентов логистического бизнеса. Обосновано значение коммуникаций в логистическом бизнесе для эффективности работы компании с клиентами, с целью увеличения ее конкурентоспособности.

Ключевые слова: digital коммуникации, менеджмент коммуникаций, логистика, бизнес - процессы, эффективность.

Introduction. Communications in the logistics business, in today's digital economy, play an important role in the efficiency of the company, both with customers and in its internal business processes. The development of Internet technologies has created new channels of communication, which are gaining more and more popularity and importance due to the simplification of access, unlimited communication and the simultaneous introduction of new digital technologies in management [3]. However, new communication channels are not only new ways and tools of interaction with various strata of the business community, but also new metrics and indicators for assessing the effectiveness of communication management.

Internet services allow the collection of data and metrics on many indicators using web analytics services, such as Google Analytics, not only in digital values and graphical representation, but also in different modes of analytics. This significantly expands the possibilities of methods for analyzing the effectiveness of business process

management and the feasibility of using digital communications [5, 22].

Today communications in the Internet environment are actively developed. Therefore this area is actively studied by many national and foreign scientists such as F. Barden, E. Van Bommel, O. Verkhovtseva, A. Voychak, O. Garafonova, O. Kayode, L. Kapustina, I. Kiriya, I. Mann, I. Mosunov, G. Ostapenko, O. Ptashchenko, B. Rebhen and others. However, the points of digital communication tools development and efficiency of their use in the logistics business are still at the initial stage and require careful research.

Goals and objectives of the study. The purpose of the presented research is to supplement the methodological approach to assessing the effectiveness of modern logistics companies' communication management. To achieve this goal, based on the analysis of the practice of logistics companies, it was possible to generalize the tools of digital communications. In addition, the existing metrics of communication tools evaluation were systematized. The expediency of their use for KPI

communication strategy was determined, too.

Presenting main material.

Communications management of modern logistics companies actively uses digital tools, because it is the key to business competitiveness in today's globalization and digitalization of the economy. In the study of the digital communications effectiveness in modern logistics business, we analyzed the digital communications experience of various scales and profiles logistics companies – both global universal logistics operators (Maersk, CMA CGM) [12, 13] and national specialized logistics operators (TIS, Nova Poshta) [14].

The analysis of communication of each company was carried out in several aspects. First, communication as a social process requires a separate special approach to defining and measuring effectiveness. Thus, the social effectiveness of communication will be defined as the ratio of the achieved result and the pre-planned goal of communication, according to the approach proposed by Vasilyk M.A. in the work "Fundamentals of communication theory". In addition, according to general approaches to evaluating the effectiveness of methods, the study considered the feasibility of using three main evaluation methods. According to the classical approach, efficiency indicators are characterized by the ability to give a result per unit cost to achieve it.

The first approach defines efficiency as the result / cost ratio. Therefore, the effectiveness of communication can be understood as the ratio of the result obtained from the communication process to the cost of obtaining it. Thus, the financial or commercial efficiency of communication is defined as the ratio of the growth of any indicator obtained as a result of communication acts to the cost of their implementation.

According to the second approach (the result – the purpose) any quantitative, but not financial indicator reached as a result of communication is defined. The third approach determines the effectiveness

through any qualitative indicator that characterizes the achievement of the goal of communication, or the degree of performance of its functions [4].

To assess the effectiveness of Internet communications in logistics in the study, it is proposed to use special KPIs (Key Performance Indicators). Thus, based on KPI data, it is possible to analyze the effectiveness of communication channels, evaluate the results of a communication tool and the degree of achievement of the goals set before the communication channel in accordance with the overall communication strategy. Similarly, the analysis of efficiency indicators makes it possible to adjust the selected plans and budget of the communication strategy of the logistics company [11, 21].

KPIs can be strategic – indicators of aggregate values; analytical, which allow you to assess trends and compare indicators over periods; operational, allowing to control indicators in real time.

The peculiarity of KPI is that for each of the tools of digital communication there is a huge number of efficiency metrics, but they should be carefully selected to assess the effectiveness of the logistics business. In the choice of KPI it is necessary to focus on the strategic goals of a particular logistics business.

For logistics business focused on work with digital communication, we highlight the main goals that affect efficiency, namely – market share, which is characterized by company recognition, audience size and participation of this audience in active business processes of the company. Also one of the main can be called the purpose of any logistics digging revenue, which is determined by conversion through potential customers and closed transactions. Among another strategic goal is customer satisfaction, which can be measured by dedication, commitment to a particular company [9, 15].

The most popular digital tools for interaction with customers among the analyzed logistics companies are sites, mobile

applications, pages in global social networks (Facebook, Twitter) [17, 18, 19] and regional social networks (Viber, Telegram), and chatbots on social or website pages.

All analyzed logistics companies have a website [12, 13, 14] which provides visitors with complete information about the company, services, work schedule and more [6]. To assess the effectiveness of the site as a tool of communication strategy, we can identify the following generalized KPIs, obtained in standard analytical packages of site maintenance:

- Total traffic – the total number of visitors to the site for a certain period of time, this indicator is quite generalized, but it is convenient to use in relation to a certain segment of the audience or source of traffic.

- Depth of view – characterizes the factor of customer behavior on the site. The average number of page views per visit estimates browsing depth. This indicator affects the position of the site when issuing search engine results, so the higher the depth of the page, the higher the position occupied by the site.

- Cost per lead (CPL) – lead is an important user in a particular or all communities who has expressed an interest in the service provided on the company's website. The cost of lead can be calculated as the ratio of the cost of marketing activity to the number of leads received. $CPL = \text{marketing costs} / \text{number of leads}$.

- Conversion Rate (CR) – this indicator shows the number of visits to the site completed by the target action (such as registration, or purchase of a service or ordering a service). The conversion rate helps you evaluate how well your chosen channel and site are working. Formula for calculating the conversion rate: $CR = (\text{number of actions} / \text{number of site visits}) * 100\%$.

- Bounce Rate (BR) – the rate shows the number of users who left the site after viewing only one page. This indicator may indicate that the site does not match the search query or has a user-friendly navigation. This indicator is calculated by the formula: $BR =$

$(\text{number of failures} / \text{number of site visits}) * 100\%$.

Let us move on to assess the effectiveness of the automated communicator – chatbot. Today, many logistics companies use chatbots to communicate with customers, it is much cheaper than creating applications for customers, in addition, fully automates the share of a particular process of communication with the customer. To qualitatively assess the effectiveness of chatbots, three categories of KPIs are used, namely data on business tasks for which a chatbot is used, metrics that reflect the demand for the bot and metrics to assess the effectiveness of dialogues in chatbots [20, 23].

The following metrics are in the category of efficiency of solving business problems of KPI:

- Reducing the load of the call center – the metric determines how successful the call center was, which is the main task of implementing chatbots in the logistics business.

- Purchase conversion – the share of visitors using the chatbot who purchased the service.

- CRM growth – helps to estimate how many chatbot users first met the company.

- Increasing the number of brand mentions.

The following metrics as KPI estimating of chatbot demanding are used:

- Number of users – shows how powerfully users use this communication channel.

- Involved users – users who at least once have contacted with the bot.

- Active users – the metric shows the usefulness of the bot, determines the number of users who have contacted with the bot.

- Repeat users – the metric shows that the user regularly uses the bot to communicate with the company.

- Number of messages read – the metric shows how interesting user content is sent through this communication channel

KPI effectiveness of dialogues can be assessed using the following metrics:

- Average session duration – depending on how fast the bot is able to respond to the client's request.

- Error rate – how correctly the robot perceives requests.

Most logistics companies, both global and regional, are actively developing their communication channels in the Internet environment have made appropriate investments in IT and not only use chatbots, but also created special mobile applications that meet the company's goals in meeting the interests and needs of customers. Let us define what KPIs are used for an estimation of mobile applications work [2, 7].

The simplest and at the same time popular metric in assessing the effectiveness of mobile applications is the number of downloads (App Installs), but this indicator is not effective enough, because downloading the program does not mean that the user will use it [1]. The next metric is the cost of the application one installation, CPI (Cost per Install), although if the program is installed but not used, this does not allow you to properly assess the effectiveness of this indicator.

One of the important financial indicators of the mobile application effectiveness is the revenue per user RPU (Revenue per User). This indicator is calculated as the ratio of total revenue from the purchase of goods or services through the application for a certain period to the total number of users. Another popular metric is the lifetime value of LTV (Lifetime Value) shows the total profit of the company, received from one client for all the time working with him or her.

Another equally important metric is the level of user retention in the application (Retention Rate), which shows customer satisfaction and how well the application develops. The Conversion Rate shows that the user of the application has become a client of the company. This is the main goal in internet marketing. Session Length of the mobile application use shows how well the application meets the needs of the user. A high session duration combined with a low

conversion rate may indicate that the program does not meet customer requirements.

Logistics companies that promote themselves in the Internet environment has increasingly begun to use social networks, creating their own pages in these cells. This allows them to increase the level of the company visibility, the level of the company's image, as well as allows one to form a community of supporters, followers and customers. The peculiarity of social networks as a communication business tool is that they offer built-in metrics for the effectiveness of the page's interaction with the audience [8]. Therefore, the metrics for assessing the effectiveness of social networks can be divided into the following categories:

- Metrics for user dynamics assessing.
- Audience feedback metrics.
- Metrics for the effectiveness of SMM management evaluating.
- Metrics for traffic and conversions estimating [16].

Metrics for assessing the dynamics of subscribers. The number of followers is not the final indicator, but the number of unfollowers shows how much business content is interesting to the user, and how well the communication strategy is chosen to promote the company on social networks. The following indicator from this category, the rate of the community audience (AGR, Audience Growth Rate) is calculated by the ratio:

$$AGR = (\text{number of new users} / \text{total number of users}) * 100\%.$$
 If one changes the formula and substitutes the value of the net increase in the numerator – the difference between the number of new users and the number left the group, one can assess the interest of the audience, the relevance of posts and advertising effectiveness, if it is connected. The next indicator is Reach. It shows the number of people who have been in contact with community posts at least once.

Next, we move on to the next group of metrics – the evaluation of user feedback. This

category is about metrics that reflect user response. The simplest and most popular of them are tags of interest – likes, comments, signs of loyalty – reposts / shares. The deeper metrics of this category include the following:

The Love Rate (LR) is determined by the number of likes in terms of audience size and is calculated by the Likes / Followers * ratio of 100%.

AR, Amplification Rate is synonymous with growth, is a ratio of Shares / Posts (number of posts) * 100%. If the AR is high, it means that we get free coverage on social networks, and this reduces the cost of attracting users. To summarize the number of user interest tags (likes, comments and reposts), one can use the Engagement Rate, EG indicator, defined as the sum: Likes + Comments + Shares. However, this figure can be calculated using another formula: $ER = (\text{sum of all involved} / \text{number of users}) * 100\%$.

The reaction of users to the business content of the company is not always positive, negative reactions must also be taken into account to assess the quality of feedback from the audience. The indicator of negative reactions (NF, Negative Feedback) is used to do this.

In the category of metrics used by SMM experts the following ones are distinguished:

PR, Post Rate Generation – shows the number of posts posted in the community during the certain period.

CR, Content Rate – shows the amount of content created during the period reported.

A more informative metric for evaluating communication with the user is the metric so called the average RT, Response Time that shows the time for which the administration responds to messages from the audience. Today this is a very important indicator of the company's communication with the customer, ideally the average response time should not exceed a day, then the customer will be considered satisfied with the communication with the brand.

The metric that estimates the proportion of questions answered by users is called the RR, Response Rate and is calculated by the

formula: $(\text{number of answers} / \text{number of questions}) * 100\%$.

The metrics used to estimate traffic and conversions on social networks are the same as those used on sites [10].

Conclusions. Evaluation of the communications effectiveness is the most important criterion for determining the quality of links and relationships built between the logistics company and the customer. The management of digital communications in the logistics business should be based on appropriate adequate, measurable and accurate performance evaluation criteria.

1. It has been proven that to communicate effectively with customers, logistics companies of all levels and scales must make extensive using of digital tools, namely websites, chatbots, mobile applications and social networks / communities.

2. The effectiveness of logistics company's communication management can be assessed on the basis of quantitative and / or qualitative indicators provided in standard packages of Internet analytics. Performance evaluation should be conducted in a strategic and operational context.

3. To assess the effectiveness of communication management in the logistics business, it is advisable to use key indicators of the effectiveness of KPI. The set of these indicators may differ for each channel, and the composition of this set depends on the strategic goals of the company.

4. It is suggested to use such main business goals of a logistics company as market share, income generation through a certain channel, customer satisfaction and customer loyalty to form generalized KPIs of communications management in the logistics business.

5. As a partial KPI, it is proposed to use such a set of indicators as the amount of total traffic, the cost of lead, the conversion rate to assess the effectiveness of the logistics company's website and its pages on social networks. When drawing conclusions about

the effectiveness of communication tools, it is necessary to keep in mind that the company's website is often an information business card, and with the help of social media pages, logistics companies have direct communication with their audience, and the ability to receive feedback.

6. To assess the communication potential of mobile applications and chatbots, it is also proposed to use a common set of KPIs namely

the duration of the customer service session, the number of completed transactions, average customer satisfaction ratings, etc.

7. It is substantiated that the most important KPIs for assessing the effectiveness of communication management are those that allow assessing the quality of the logistics company digital channels interaction with its customers, including feedback quality and customer's loyalty and consistency.

References

1. Vertaim, K. (2010). Tsyfrovyi marketing. Kak uvelichit prodazhi za dopomohoiu sotsialnykh merezh, blohiv, viki-resursiv, mobilnykh telefoniv ta inshykh suchasnykh tekhnolohii (Digi Marketing) [Digital marketing. How to increase sales through social networks, blogs, wikis, resources, mobile phones and other modern technologies]. Alpina Publisher, Yurait [in Russian].
2. Harafonova, O. I. (2014). Vykorystannia internet-marketynhu u marketynhovii diialnosti pidpriemstva [Using internet marketing in the marketing of the company]. Kherson [in Ukrainian].
3. Kolosok V.M., Lazarevska Yu.A. (2019) Menedzhment komunikatsii v internet seredovyschi dlia prosuvannia lohistychnoho biznesu / V.M. Kolosok Yu.A. Lazarevska // Ekonomichnyi visnyk Natsionalnoho hirnychnoho universytetu. – 2019. – №4(68). S. 155-163. [in Ukrainian].
4. Kolosok V.M., Lazarevskaya Yu.A.(2019) Opredelenie effektivnosti biznes kommunikatsiy v logistike / V.M. Kolosok, Yu.A. Lazarevskaya // Tezy dopovidei mizhnarodnoi naukovo-tekhnichnoi konferentsii "Universytetska nauka - 2019". – Mariupol : Vydavnytstvo DVNZ "PDTU", 2019. - S 80-81. [in Russian].
5. Lazarevska Yu.A.(2019) Suchasni internet merezhi yak instrument komunikatsii dlia lohistychnykh pidpriemstv / Yu.A. Lazarevska // Materialy II Vseukrainskoi naukovo-praktychnoi internet- konferentsii studentiv, aspirantiv ta molodykh vchenykh za tematykoiu «Suchasni kompiuterni systemy ta merezhi v upravlinni». – Kherson., 2019. - S 344-346. [in Ukrainian].
6. Lazarevska Yu.A (2020). Suchasnyi instrumentarii media komunikatsii yak draiver lohistychnoho biznesu / Yu.A. Lazarevska //: Zbirnyk materialiv XXII pidsumkovoï naukovo-praktychnoi konferentsii vykladachiv MDU «Aktualni problemy nauky ta osvity». – Mariupol : Vydavnytstvo MDU, 2020. - S 48-50. . [in Ukrainian].
7. Lytovchenko, I.L., & Pylypchuk, V.P. (2008). Internet-marketynh [Internet-marketing]. Tsentr uchbovoi literatury [in Ukrainian].
8. Logistika ta prosuvannya u socialnih merezhah [Elektronnij resurs]. – Rezhim dostupu: <https://s2b-group.net/post/791> [in Ukrainian].
9. Mozhova, V.H. (2013). Instrumenty Internet-marketynhu ta yikh perevahy dlia suchasnykh ukrainskykh pidpriemstv [Internet marketing tools and their benefits for modern Ukrainian companies]. Efektyvna ekonomika – Effective economy, 10, 79-86 [in Ukrainian]

10. Ptashchenko, O. V. (2015). Rozvytok modelei komunikatsii v merezhi Internet [Development of communication models in the Internet]. Sotsialno-ekonomichniy rozvytok rehioniv v konteksti mizhnarodnoi intehtratsii – Socio-economic development of regions in the context of international integration, 19 (8), 31–41 [in Ukrainian].
11. Rebhen, B. (2015). Ot klikov k prodazham. Kak povyisit prodazhi cherez optimizatsiyu konversii [From clicks to sales. How to increase sales through conversion optimization]. M: Mann, Ivanov i Ferber [in Russian]
12. Sait lohistychnoi kompanii CMA CGM Group [Elektoniyi resurs]. – Rezhym dostupu: <https://www.cma-cgm.com> [in English].
13. Sait lohistychnoi kompanii Maersk [Elektoniyi resurs]. – Rezhym dostupu: https://www.maersk.com/?gclid=EAlalQobChMlnZ3Dx6WV6wIVVJ3Ch2ylAlaEAAYASAAEgKTd_D_BwE&gclsrc=aw.ds [in English].
14. Sait lohistychnoi kompanii TIS [Elektoniyi resurs]. – Rezhym dostupu: <http://www.tis.ua> [in Russian].
15. Sokhatska O.M., Lehkyi O.A. (2017) Efektyvnist tsyfrovyykh marketynhovykh komunikatsii: vid postanovky mety do otsiniuvannia rezultatu / O.M. Sokhatska, O.A. Lehkyi // Marketynh i tsyfrovi tekhnolohii. – 2017. – T1, №2 S. 4-31.
16. Socialni merezhi & logistichni kompaniyi [Elektoniyi resurs]. – Rezhim dostupu: <https://logistics-ukraine.com/2018/02/12/socialni-merezhi-logistichni-komani> [in Ukrainian].
17. Storinka u Facebook kompanii CMA CGM [Elektoniyi resurs]. – Rezhym dostupu: <https://www.facebook.com/cmacgm> [in English].
18. Storinka u Facebook kompanii Maersk [Elektoniyi resurs]. – Rezhym dostupu: <https://www.facebook.com/Maersk> [in English].
19. Storinka u Facebook kompanii TIS [Elektoniyi resurs]. – Rezhym dostupu: <https://www.facebook.com/tis.terminals> [in Russian].
20. Uraev D.A. (2010) Metriki dlya otsenki kachestva chat bot prilozheniy / D.A. Uraev // Nauka, tehnika i obrazovanie. – 2019. – №9(62). – S 36-40 [in Russian].
21. Handley A., Chapman A. (2010) Content Rules: How to Create Killer Blogs, Podcasts, Videos, Ebooks, Webinars (and More) That Engage Customers and Ignite Your Business. - John Wiley & Sons, 2010. - 326 p. [in English].
22. Kumar P., Hsiao M., Chiu B. (2009) Generations of Consumers and the consumer Gegenerated // Journal of integrated marketing communications, 2009. - 312 p. [in English].
23. Strauss L. The Secret to Writing a Successful and Outstanding Blog. The Insider's Guide to the Conversation's Changing How Business Works. Access Mode: <http://www.successful-blog.com/> [in English].

Список використаних джерел

1. Вертайм К. Цифровой маркетинг. Как увеличить продажи с помощью социальных сетей, блогов, вики-ресурсов, мобильных телефонов и других современных технологий (Digi Marketing: The Essential Guideto New media & Digital Marketing) / К. Вертайм, Я. Фенвик. – М. : Издательство Альпина Паблишер, Юрайт, 2010. – 384 с.

2. .Гарафонов О. І. Використання інтернет-маркетингу у маркетинговій діяльності підприємства / О.І. Гарафонов., за ред. Г. Г. Савіної. Херсон, 2014. 288 с.
3. Колосок В.М., Лазаревська Ю.А. Менеджмент комунікацій в інтернет середовищі для просування логістичного бізнесу / В.М. Колосок Ю.А. Лазаревська // Економічний вісник Національного гірничого університету. – 2019. – №4(68). С. 155-163.
4. Колосок В.М., Лазаревська Ю.А. Определение эффективности бизнес коммуникаций в логистике / В.М. Колосок, Ю.А. Лазаревская // Тези доповідей міжнародної науково-технічної конференції "Університетська наука - 2019". – Маріуполь : Видавництво ДВНЗ "ПДТУ", 2019. - С 80-81.
5. Лазаревська Ю.А. Сучасні інтернет мережі як інструмент комунікації для логістичних підприємств / Ю.А. Лазаревська // Матеріали II Всеукраїнської науково-практичної інтернет-конференції студентів, аспірантів та молодих вчених за тематикою «Сучасні комп'ютерні системи та мережі в управлінні». – Херсон., 2019. - С 344-346.
6. Лазаревська Ю.А. Сучасний інструментарій медіа комунікації як драйвер логістичного бізнесу / Ю.А. Лазаревська //: Збірник матеріалів XXII підсумкової науково-практичної конференції викладачів МДУ «Актуальні проблеми науки та освіти». – Маріуполь : Видавництво МДУ, 2020. - С 48-50.
7. Литовченко І.Л. Internet-маркетинг : навч. посіб. / І.Л. Литовченко, Л.В. Пилипчук. – К. : Центр навчальної літератури, 2008. – 182 с.
8. Логістика та просування у соціальних мережах [Електронний ресурс]. – Режим доступу: <https://s2b-group.net/post/791>
9. Мозгова В.Г. Інструменти Internet-маркетингу та їх переваги для сучасних українських підприємств / Г.В. Мозгова // Ефективна економіка. – 2013. – №10. – С. 79-86.
10. Птащенко О. В. Розвиток моделей комунікацій в мережі Інтернет / О.В. Птащенко // Соціально-економічний розвиток регіонів в контексті міжнародної інтеграції. – 2015. № 19 (8). С. 39–41.
11. Рэбхэн Б. От кликов к продажам. Как повысит продажи через оптимизацию конверсии / Б. Рэбхэн. с англ. Ю. Дворецкой. М. : Манн, Иванов и Фербер, 2015. 304 с.
12. Сайт логістичної компанії CMA CGM Group [Електронний ресурс]. – Режим доступу: <https://www.cma-cgm.com>
13. Сайт логістичної компанії Maersk [Електронний ресурс]. – Режим доступу: https://www.maersk.com/?gclid=EAlalQobChMlnZ3Dx6WV6wIVV-J3Ch2yIAaEAAAYASAAEgKTd_D_BwE&gclid=aw.ds
14. Сайт логістичної компанії TIS [Електронний ресурс]. – Режим доступу: <http://www.tis.ua>
15. Сохацька О.М., Легкий О.А. Ефективність цифрових маркетингових комунікацій: від постановки мети до оцінювання результату / О.М. Сохацька, О.А. Легкий // Маркетинг і цифрові технології. – 2017. – Т1, №2 С. 4-31.
16. Соціальні мережі & логістичні компанії [Електронний ресурс]. – Режим доступу: <https://logistics-ukraine.com/2018/02/12/соціальні-мережі-логістичні-компанії>
17. Сторінка у Facebook компанії CMA CGM [Електронний ресурс]. – Режим доступу: <https://www.facebook.com/cmacgm>

-
18. Сторінка у Facebook компанії Maersk [Електроний ресурс]. – Режим доступу: <https://www.facebook.com/Maersk>
19. Сторінка у Facebook компанії TIS [Електоний ресурс]. – Режим доступу: <https://www.facebook.com/tis.terminals>
20. Ураев Д.А. Метрики для оценки качества чат бот приложений / Д.А. Ураев // Наука, техника и образование. – 2019. -- №9(62). – С 36-40
21. Handley A., Chapman A. Content Rules: How to Create Killer Blogs, Podcasts, Videos, Ebooks, Webinars (and More) That Engage Customers and Ignite Your Business. - John Wiley & Sons, 2010. - 326 p.
22. Kumar P., Hsiao M., Chiu B. Generations of Consumers and the consumer Gegenerated // Journal of integrated marketing communications, 2009. - 312 p.
23. Strauss L. The Secret to Writing a Successful and Outstanding Blog [Електроний ресурс]. The Insider's Guide to the Conversation That's Changing How Business Works. Режим доступу: <http://www.successful-blog.com/> свободный – Загл. с экрана. – Яз. англ.

UDC 005.6: 656

DOI: <https://doi.org/10.46783/smart-scm/2020-2-7>

JEL Classification: C 52; D 11; E 21; L 89; M 31; R 40.

Received: 30 July 2020

Chornopyska N.V. PhD (Economics), Associate Professor, Associate Professor at department marketing and logistics at Lviv Polytechnic National University (Ukraine)

ORCID – 0000-0001-9074-7607

Researcher ID –

Scopus author id: –

Bolibrukh L.I. Student at department marketing and logistics at Lviv Polytechnic National University (Ukraine)

ORCID – 0000-0003-2407-6838

Researcher ID –

Scopus author id: –

THE INFLUENCE OF THE COVID-19 CRISIS ON THE FORMATION OF LOGISTICS QUALITY

Natalyia Chornopyska, Lidiia Bolibrukh. *"The influence of the COVID-19 crisis on the formation of logistics quality".* Relevance of research. COVID-19 crisis has led to an unequal consequence. Some industries collapsed, some - reached the top of their development. Thus, E-commerce passed a three-year path during the pandemic. Such rapid growth has led to logistical reconsideration of the e-commerce market, which raises the issue of logistics services. Despite the presence of many methodological and applied developments, the issue of measurability of logistics quality, a set of evaluation criteria for the quality of logistics services remains debatable, and due to recent events caused by the COVID-19 pandemic, suitability of applied evaluation criteria to variable environmental requirements. Thus, the problem of market value transformation of logistics needs further research.

The purpose of the study is to further develop guidelines for assessing the quality of logistics in view of current post-COVID-19 challenges. For this goal achievement it was necessary to solve the following tasks: to conduct marketing research on the quality of logistics of e-commerce in quarantine and, on this basis, to make conclusions about the transformation of the value of logistics and B2C market, which will be reflected in a set of evaluation criteria for logistics quality.

Methods: express survey of 240 e-consumers in 19 regions of Ukraine during April-May 2020 on the basis of an online-questionnaire created on Google Forms platform and shared on social networks like Facebook, Instagram, Telegram and Viber.

Conclusions and value added. The results of the study have showed that in modern conditions the formation of the quality of logistics in the B2C market is influenced by the following criteria: flexibility, timeliness, completeness, wholeness, security and E2E-interaction. It is important for consumers to be able to independently choose additional delivery functions - place, time, delivery period, method of payment, which indicates the need to develop flexibility in the services of logistics operators. The modern consumer values his time, respectively, so the logistics service provider doesn't have the right to make a mistake in completing the order or improper

storage of goods. The transformation of the value of logistics services, in the post-COVID-19 conditions, concerns online interaction and speed of data exchange with the logistics service provider: contactless technologies, gadgets and applications that provide seamless online work, regardless of location. Online interaction, in particular online shopping, according to the study, attracts them with its simplicity, the ability to compare prices on different platforms, the availability of a wide range of goods and saving time. Thus, the value of the benefits of digitalization increases. Those logistics providers that are more technologically advanced have a significant competitive advantage. E2E determine the value.

Keywords: COVID-19 crisis; e-commerce market; online shopping; e-consumer; quality of logistics; logistics provider; methods for evaluation the quality of logistics; evaluation criteria; value; E2E-interaction; logistics services

Наталія Чорнописька, Лідія Болибрух. «Вплив кризи COVID-19 на формування якості логістики». Актуальність дослідження. Криза COVID-19 розподілилася нерівномірно. Окремі галузі занепали, інші – досягли свого піку. Так, e-commerce за період пандемії пройшла трьохрічний шлях. Такий стрімкий ріст призвів до перегляду логістичної складової ринку e-commerce, що актуалізує питання якості логістичних послуг та дослідження проблеми трансформації цінності логістики з погляду ринку.

Метою дослідження є подальший розвиток методичних положень оцінювання якості логістики з огляду сучасних викликів Post- COVID-19. Для досягнення поставленої мети необхідно було вирішити такі завдання: провести маркетингове дослідження якості логістики інтернет-торгівлі в умовах карантину і, на цій основі, зробити висновки відносно трансформації цінності логістики та ринку B2C, що знайде своє відображення в наборі оцінних критеріїв якості логістики.

Методика дослідження: експрес-опитування 240 е-споживачів у 19 областях України протягом квітня-травня 2020 р. на підставі створеної за допомогою Google Forms та розповсюдженої у таких соціальних мережах як Facebook, Instagram, Telegram та Viber анкети.

Висновки. Як показали результати проведеного дослідження, в сучасних умовах на формування якості логістики на ринку B2C впливають такі критерії: гнучкість, вчасність, комплектність, цілісність, безпечність та E2E-взаємодія. Трансформація цінності логістичної послуги, в post-COVID-19 середовищі, стосується он-лайн взаємодії та швидкості обміну даними з постачальником логістичної послуги: безконтактні технології, гаджети та додатки, що забезпечують безперебійну он-лайн роботу, незалежно від місця знаходження. Он-лайн взаємодія, зокрема он-лайн покупки, за результатами дослідження, приваблюють їх своєю простотою, можливістю порівнювати ціни на різних платформах, доступністю широкого асортименту товарів та економією часу. Підвищення рівня діджиталізації спровокувало зміну фокусу цінності логістичної послуги для споживачів, тому власна мобільність та можливість економії часу для сучасного клієнта стали пріоритетними. Отже, збільшується цінність переваг, що дає діджиталізація. Ті логістичні оператори, які є більш просунутими технологічно, мають суттєву конкурентну перевагу. E2E визначає цінність.

Ключові слова: криза COVID-19; ринок e-commerce; інтернет-покупки; е-споживач; якість логістики; логістичний оператор; методи оцінки якості логістики; оцінні критерії; цінність; E2E-взаємодія; логістичні послуги.

Наталья Чернописька, Лидия Болибрух. «Влияние кризиса COVID-19 на формирование качества логистики». Актуальность исследования. Кризис COVID-19 распределился неравномерно. Некоторые отрасли упали, другие – достигли своего пика. К примеру, e-commerce за период пандемии прошла путь на три года вперед. Такой стремительный рост привел к пересмотру логистической составляющей рынка e-commerce, что актуализирует вопрос качества логистических услуг, исследования проблемы трансформации ценности логистики с точки зрения рынка.

Целью исследования является дальнейшее развитие методических положений оценки качества логистики с учетом современных вызовов Post- COVID-19. Для достижения поставленной цели необходимо было решить следующие задачи: провести маркетинговые исследования качества логистики интернет-торговли в условиях карантина и на этой основе сделать выводы

относительно трансформации ценности логистики и рынка B2C, что найдет свое отражение в наборе оценочных критериев качества логистики.

Методика исследования: экспресс-опрос 240 е-потребителей в 19 областях Украины в течение апреля-мая 2020 на основании созданной с помощью Google Forms и распространенной в таких социальных сетях как Facebook, Instagram, Telegram и Viber анкеты.

Выводы. Как показали результаты проведенного исследования в современных условиях на формирование качества логистики на рынке B2C влияют следующие критерии: гибкость, своевременность, комплектность, целостность, безопасность и E2E-взаимодействие. Трансформация ценности логистической услуги, в post-COVID-19 условиях, касается он-лайн взаимодействия и скорости обмена данными с поставщиком логистической услуги: бесконтактные технологии, гаджеты и приложения, обеспечивающие бесперебойную онлайн работу, независимо от места нахождения. Онлайн-взаимодействие, в том числе он-лайн покупки, по результатам исследования, привлекают их своей простотой, возможностью сравнивать цены на разных платформах, доступностью широкого ассортимента товаров и экономией времени. Повышение уровня диджитализации спровоцировало изменение фокуса ценности логистической услуги для потребителей, так собственная мобильность и возможность экономии времени для современного клиента стали приоритетными. Следовательно, увеличивается ценность преимуществ, которые дает диджитализация. Те логистические провайдеры, которые являются более продвинутыми технологически, имеют существенное конкурентное преимущество. E2E определяет ценность.

Ключевые слова: кризис COVID-19; рынок e-commerce; интернет-покупки; е-потребитель; качество логистики; логистический провайдер; методы оценки качества логистики; оценочные критерии; ценность; E2E-взаимодействий; логистические услуги

Introduction. The world was gripped by an unpredictable coronavirus pandemic that forced quarantine restrictions on more than a third of the world's population. Such drastic actions have led to unpredictable consequences for the economy and development of many countries at the global level, as well as the purchasing power of the population and its mobility. In particular, the pandemic has a great impact on the logistics industry, which is now demonstrating its flexibility and importance in the general state of countries' lives. In such extreme conditions, humanitarian logistics has become critical [2].

COVID-19 crisis wasn't smooth. Some industries collapsed, some - reached the top of their development. The COVID-19 pandemic has led to the accelerated growth of e-commerce. Analyzing the e-commerce market in Ukraine, it is tracing the rapid development of the industry in recent years. In particular, in 2018, the Ukrainian market was ranked second in Europe in terms of growth rate (30%), in 2019 it was 17%, and, according to preliminary forecasts, in 2020 - 15% [3]. However, an external factor became unpredictable - the coronavirus pandemic,

which stimulated a sharp increase in demand for online shopping. In April 2020 the E-commerce market reached the mark of 2023 (within 8 weeks the path has been covered in 3 years) [4]. Such rapid growth has become a serious challenge for logistics, which has highlighted the problem of quality logistics services.

The works of such founders of logistics science as Lambert D., Bauersachs D., Pfohl H. and domestic classics - Krykavsky E, Grygorak M., especially their latest ones, are devoted to theoretical and applied issues of logistics quality [5,6]. Logistics quality assessment methodologies have been developed by leading think tanks and consulting centers, including the World Bank, which calculates and publishes the Logistics Efficiency Index (LPI), where quality is one of the six sub-indices [7]. The following scientists made a significant contribution to the coverage of the method of assessing the quality of enterprise logistics: Meffert G. [8], Parasuraman A. [9], Bruhn M. [10], Voźniak J. [11], Fraś J. [12], Nakonechna. T., Gryniv N. [13].

At the same time, despite the availability of many methodological and applied works,

the issue of logistics quality assessment, a set of evaluation criteria for the quality of logistics services is still debatable (there is no united approach or view, lack of coherence and formalization), and due to recent developments and the question of the suitability of the applied evaluation criteria for the changing requirements of the environment. Thus, the problem of market value transformation of logistics needs further research.

The purpose and objectives of the study. The purpose of the study is to further develop guidelines for assessing the quality of logistics in view of current post-COVID-19 challenges. For the achievement of this goal it was necessary to solve the following tasks: to

conduct marketing research on the quality of logistics of e-commerce in quarantine and, on its basis, to make conclusions about the transformation of the value of logistics and B2C market, which will be reflected in a set of evaluation criteria for logistics quality.

Primary materials and results. The marketing research was conducted in April-May 2020 and included an express survey based on an online questionnaire created on Google Forms platform and shared on social networks like Facebook, Instagram, Telegram and Viber, which served as the main research tool. The research methodology provided details of objectives, search questions and hypotheses (parameters) that should be defined (Table 1).

Table 1

Objectives, search questions, hypotheses (parameters) of study

Objectives of the study	Search questions	Hypotheses (parameters)
1. To assess the demand in the online format in the Ukrainian market and to determine the impact of quarantine on the online shopping intensification.	How often do consumers shop online?	In the structure of trade, online sales are still inferior to offline sales, but there is a significant increase in demand for online services during quarantine restrictions.
	Did consumers make online purchases during quarantine?	
	Will consumer buying behavior change after quarantine?	
	What types of factors affect online shopping?	The main advantage of online shopping is a wide range of hard-to-reach products and time savings.
	What goods are in demand during quarantine?	The largest share of online shopping structure is accounted for by expensive appliances, clothing and restaurant meals, but during quarantine the demand for food and household chemicals rose sharply.
2. To identify the main logistics operators that deliver online stores goods, method of delivery and determine the level of quality of logistics services.	What platforms are used for goods ordering?	Most often, orders are placed on specialized online trading platforms or social networks.
	How was the delivery carried out?	The service of goods delivery to the post office is popular, but on quarantine conditions consumers more often use courier delivery.
	Which postal operators are serving e-commerce market?	"Nova Poshta" has the largest volume of deliveries to the branch and via courier in Ukraine, but "Ukrposhta" makes international shipments.
	Which courier services are the most popular?	

End of Table 1

	What evaluation criteria can be used to determine the quality of logistics services of a postal operator or courier service?	It is assumed that the most important for buyers are the timeliness of delivery, its completeness and flexibility, but in quarantine, these criteria may change.
3. To clarify the profile of the target audience, whether it is possible to change the structure of consumers after quarantine.	Sex?	Most often, online stores orders are made by progressive young people under 25 who live in large cities, study or work there. Most consumers are women. In the fast life pace, orders are used to by smartphones.
	Age?	
	Activity?	
	Type of settlement?	
	What electronic device do you use to make online purchases?	

Complied by authors.

Questionnaire questions were developed based on the search questions transformation.

The survey started at the end of April 2020 and covered 240 respondents, the breadth of the geography of the study - 19

regions, of which the largest number of participants are from Lviv (61%), Kyiv (17.4%) and Ivano-Frankivsk (8.3%) regions. Geographical coverage and profile of the target audience of the study are presented in Fig.1a-1b.

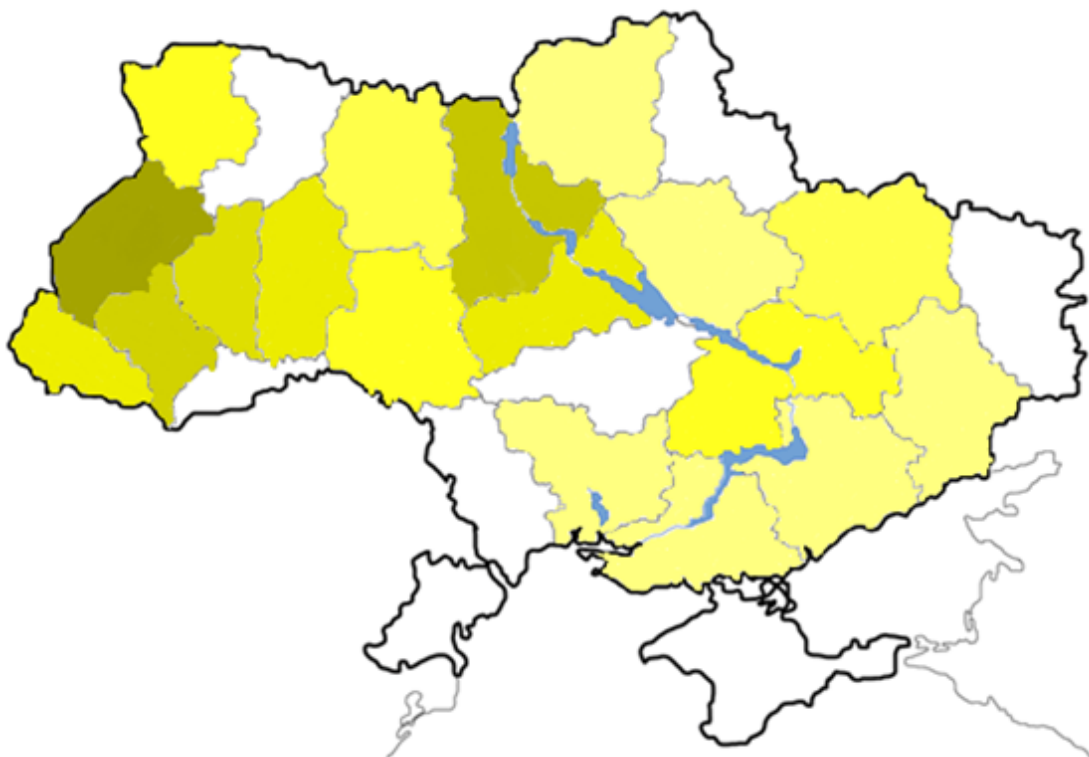


Figure 1a. Geographical coverage and profile of the target audience of the study

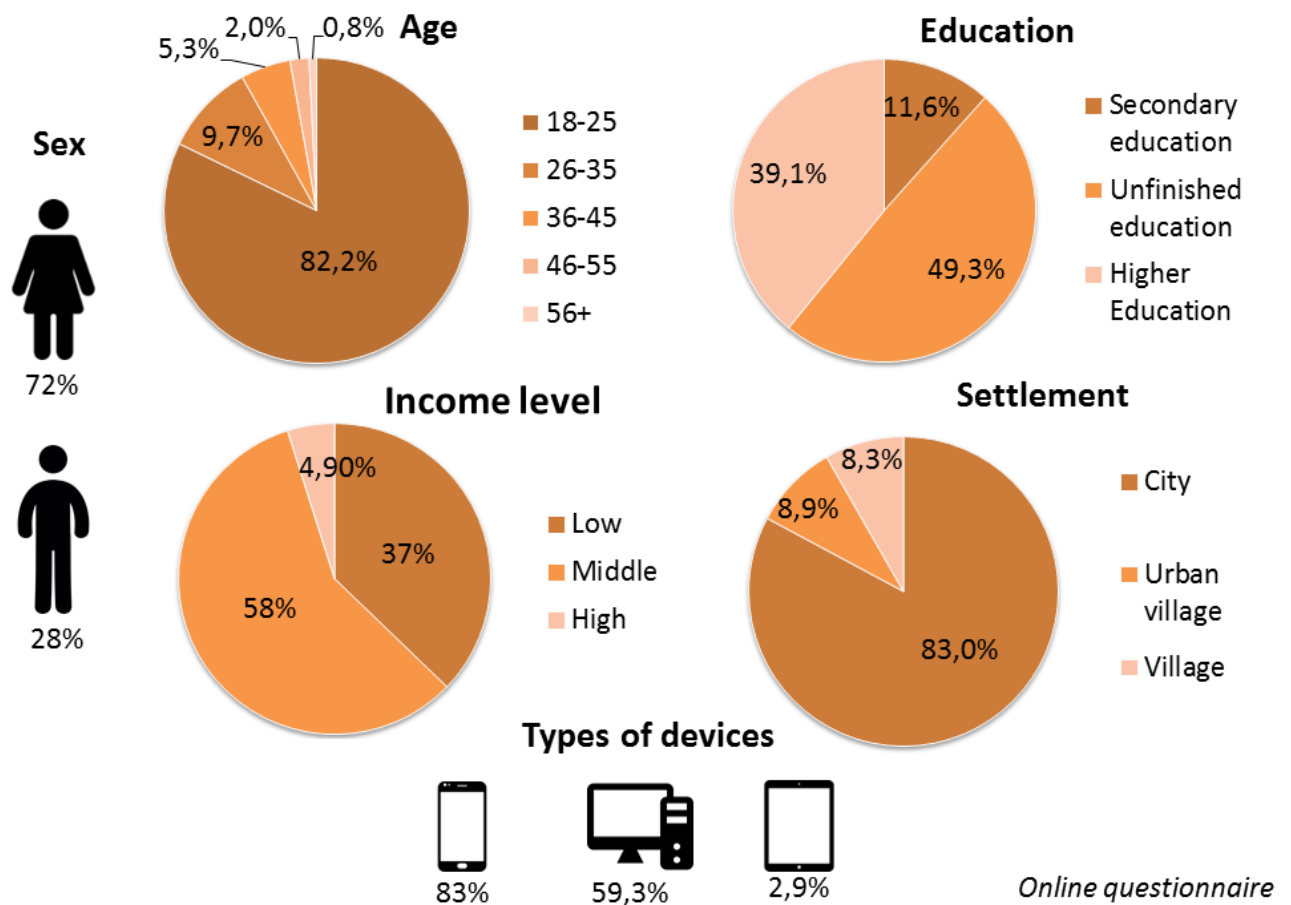


Figure 1b. Geographical coverage and profile of the target audience of the study
 Compiled and calculated by authors based on results of provided survey

The profile of the target audience of online commerce confirms that the majority of respondents are women aged 18 to 25 who study or work and have an average income. Virtually everyone lives in cities where more logistics operators are available, and uses smartphones (83%) and computers (59.3%) for online shopping.

An infographic of the survey results on the demand for online shopping in the Ukrainian market during quarantine is presented in Fig.2. According to it we can conclude that online shopping in Ukraine is

quite popular (58.3%). Despite the fact that online shopping has entered the domestic market quite recently, today it has its target audience, which uses such services both under normal conditions and during quarantine restrictions (19.6%). Now we can see some growth in demand for online products (76.6%), but according to most respondents, their shopping habits will not change after quarantine, and only 20.6% are convinced that they will use online services more often.

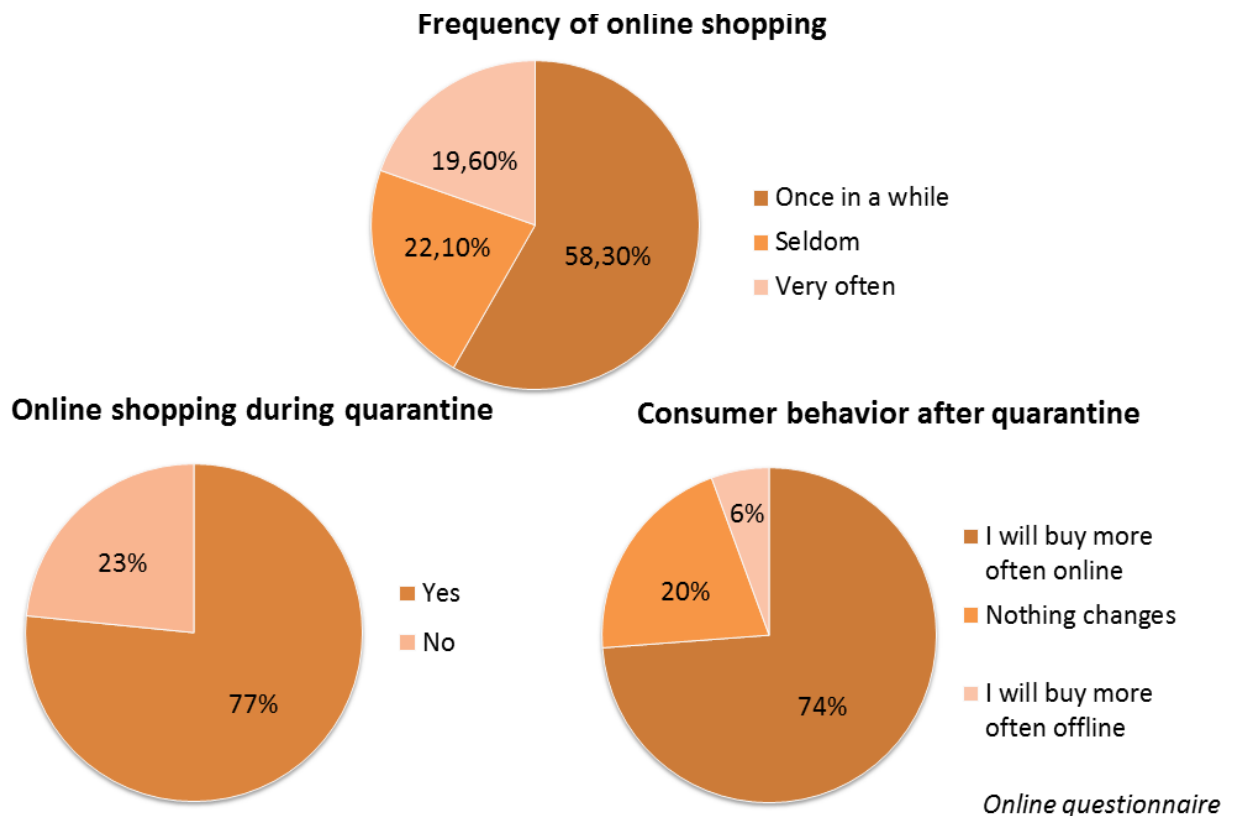


Figure 2. Buying behavior during quarantine
 Compiled and calculated by authors based on results of provided survey

Online shopping provides those consumer values that are difficult for ordinary offline stores to provide, and what are the most valuable for shoppers (Fig. 3). It was assumed that in the conditions of quarantine unpredictable circumstances (restriction of movement of people, reduction of product range due to mass purchase) will become a significant factor influencing demand, but respondents note the following criteria: convenience of ordering, simple process of ordering products (67.2%); possibility to compare prices on different platforms (57.6%); access to a wider range of goods that are limited or not represented in the domestic market (57.1%); saving time (52.1%).

At the same time, consumers of online stores more often buy clothes, shoes and accessories (56.7%), cosmetics and perfumes (39.4%) and appliances (33.3%), due to the favorable offers of online stores for these

goods, a wider range and increase in the total time spent at home.

The infographic of the results in Fig. 4 shows the results of the survey on the quality of services for ordering and delivery of goods, as well as determines the most commonly used methods of provision.

Thus, consumers equally often form their orders either on the official websites of stores, or in their absence on special online trading platforms, such as ROZETKA, OLX, PROM, Kasta (69.3%), which have a wide range of different products. Such sites contain all the evaluation criteria that determine the consumer value for consumers. Buyers often order clothes, accessories and cosmetics through Instagram accounts. At the same time, delivery services as Glovo, Uber Eats, Raketa (28.1%) have their network only in large cities and usually supply restaurants meals or food from supermarkets.

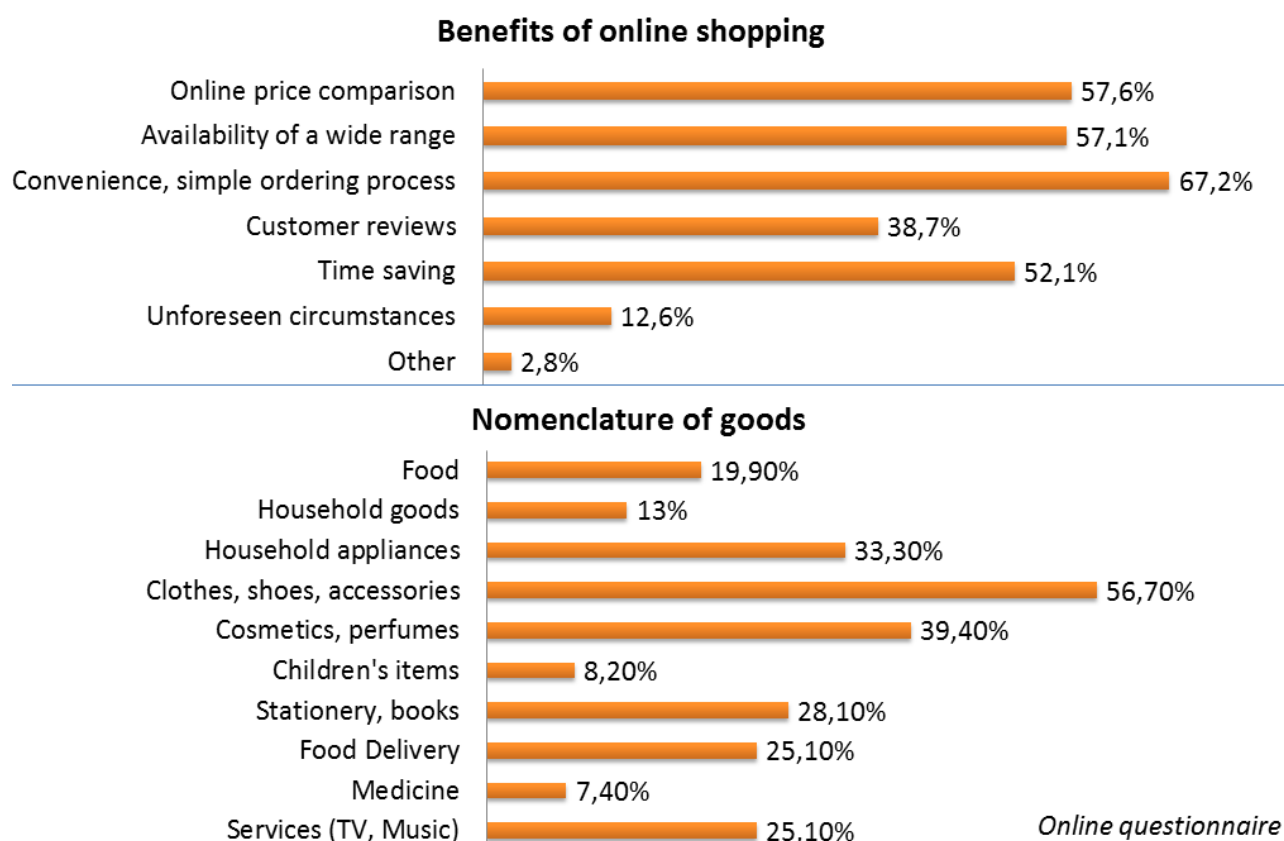
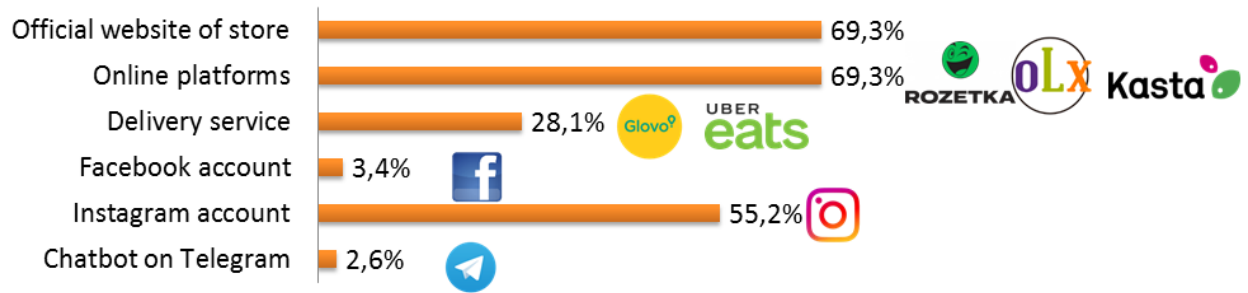


Figure 3. Infographics of online shopping during quarantine
 Compiled and calculated by authors based on results of provided survey

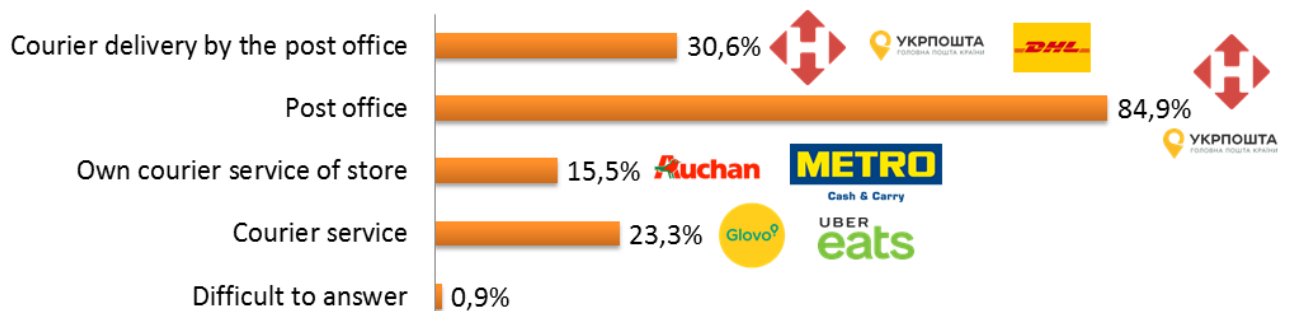
According to the survey, most orders are picked up by buyers at the operator's post offices (84.9%), the most popular of which is Nova Poshta, which delivers orders within Ukraine. UkrPoshta, Meest Express, DHL etc.

deliver goods from abroad. Despite quarantine, the services of a postal operator courier (30.6%) or a courier service such as Glovo, Uber Eats, Raketa (23.3%) are used much less.

Online platforms for ordering

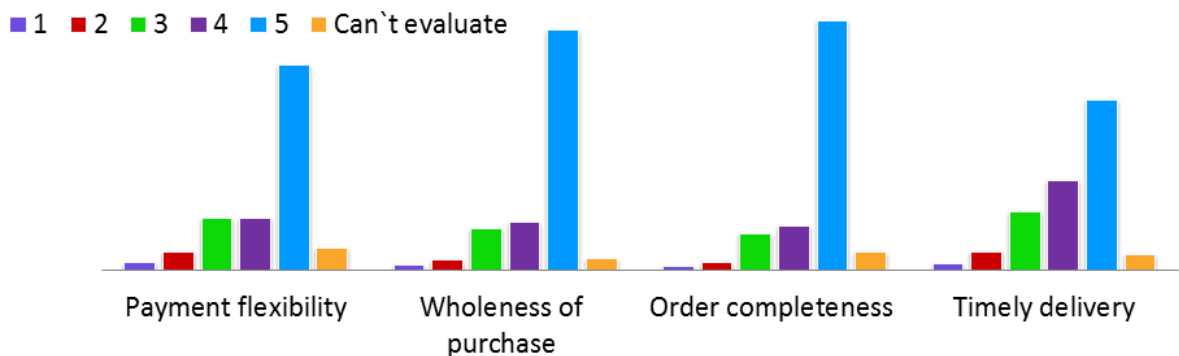


Delivery of goods

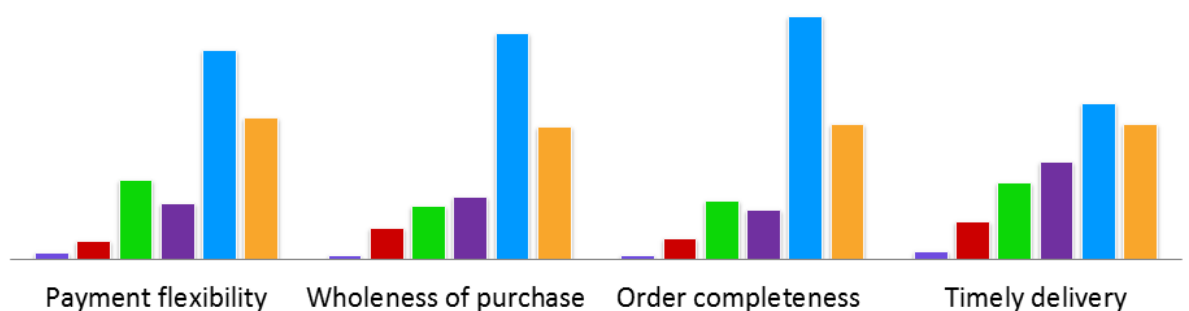


Online questionnaire

Evaluative criteria for delivery of goods to the post office



Evaluative criteria for courier delivery



Online questionnaire

Fig.4. Infographics of the quality of online shopping logistics services
 Compiled and calculated by authors based on results of provided survey

Assessing the quality of work of the postal operator of the provided courier service, consumers said that they were satisfied with the delivery services and praised the presented criteria, but the most important among them were: completion of the order according to customer requirements, integrity of the purchase, namely product appearance in the process, and payment flexibility. At the same time, due to the pandemic, the demand for online shopping has increased, which has provoked full employment of staff, loading of all rolling stock and, consequently, reduced punctuality.

Conclusions. The marketing research was preceded by the author's survey study on the evaluation of the quality of logistics. Among the ten methods studied, the choice of the authors was focused on the method of SERVQUAL, from which 22 indicators were borrowed that characterize the quality of logistics, grouped by 5 features: material aspect; reliability; satisfaction of client's requirements; professionalism of employees; empathy and knowledge of customer needs. However, at the trial stage, the researchers faced the following problems: 1) some indicators were perceived ambiguously and needed further clarification (for example, from the group "material aspect of the service"); 2) some criteria were perceived as appropriate, and this should not be asked, but should be performed as best as possible (the group "empathy and knowledge of needs" was rejected); 3) some criteria, according to respondents, do not create added value to the consumer, so they were also excluded from the list. As a result, 22 indicators were reduced to 4: completeness, wholeness, flexibility and

timeliness. And, - the criterium "safety" which provides observance of sanitary requirements (disinfection, use of protective suits, observance of social distance etc.) was added.

According to the results of the study, it is important for consumers to be able to independently choose additional delivery functions - place, time, delivery period, method of payment, which indicates the need to develop flexibility in the services of logistics operators. The modern consumer values his time, respectively, so the logistics service provider doesn't have the right to make a mistake in completing the order or improper storage of goods.

The transformation of the value of logistics services, according to respondents, concerns online interaction and speed of data exchange with the logistics service provider: contactless technologies, gadgets and applications that provide seamless online work, regardless of location. Online interaction, in particular online shopping, according to the study, attracts them with its simplicity (69.7%), the ability to compare prices on different platforms (58.8%), the availability of a wide range of goods (57.5%) and saving time (52.9%). Thus, the value of the benefits of digitalization increases. Those logistics providers that are more technologically advanced have a significant competitive advantage. E2E determine the value.

The obtained results change the understanding of the fullness of the quality of logistics evaluation criteria that are valuable for the target market, but do not solve the problem of measurability of the quality of logistics services, which will be the prospect of further research.

References

1. Kaplan J, Frias L, McFall-Jordan.(2020). A third of the global population is on coronavirus lockdown — here's our constantly updated list of countries locking down and opening up. Business Insider. URL: <https://www.businessinsider.com/countries-on-lockdown-coronavirus-italy-2020-3> (Accessed April 2020)

2. One in four retailers report "significant" supply chain issues due to coronavirus (2020). Logistics Express. URL: <https://www.logistik-express.com/one-in-four-retailers-report-significant-supply-chain-issues-due-to-coronavirus/> (Accessed April 2020)
3. Симоненко, К. (2020). Тихіше їдеш, далі будеш: підсумки українського e-commerce і логістики за 2019-й. RAU Ukraine. URL: <https://rau.ua/novyni/pidsumky-e-commerce-2019/> (Accessed April 2020)
4. Bank of America, U.S. Department of Commerce (2020). US E-commerce Penetration, ShawSpring Research 2020 (Accessed April 2020)
5. Krykavskyy, Ye., Pokhylchenko, O., Hayvanovysh, N. (2019). Digitalization of supply chains: new paradigm. 10th International Conference on Applied Economics Contemporary Issues in Economy, Torun, Poland, 27-28 June 2019 (Vol. 1). Institute of Economic Research, 103-108. DOI: 0.24136/eep.proc.2019.4
6. Hryhorak M., Trushkina N., Tadeusz Popkowski, Molchanova K. (2020) "Digital transformations of logistics customer service business models". Intellectualization of logistics and Supply Chain Management. [Online], vol.1, p.57-75, available at: <https://smart-scm.org/en/journal-1-2020/hryhorak-mariia-trushkina-natalia-molchanova-kateryna-digital-transformations-of-logistics-customer-service-business-models/> (Accessed 24 May 2020). DOI: <https://doi.org/10.46783/smart-scm/2020-1-6>.
7. World Bank (2018). LPI Country Score Card: Ukraine 2018. URL: <https://lpi.worldbank.org/international/scorecard/radar/254/C/UKR/2018#chartarea> (Accessed April 2020)
8. Meffert, H., Bruhn, M., & Hadwich, K. (2015). Dienstleistungsmarketing. Wiesbaden: Springer Fachmedien Wiesbaden.
9. Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1985). A conceptual model of service quality and its implications for future research. Journal of marketing, 49(4), 41-50.
10. Bruhn, M. (2006). Qualitätsmanagement für Dienstleistungen. Springer Berlin Heidelberg.
11. Woźniak, J. (2017). Ocena przydatności metod SERVQUAL i CSI w kontekście badania logistycznej obsługi klienta. Przedsiębiorstwo we współczesnej gospodarce – teoria i praktyka, 21(2), 237-249.
12. Frąś, J. (2014). Wybrane instrumenty pomiaru jakości usług logistycznych. Zeszyty Naukowe Uniwersytetu Szczecińskiego, 803(6).
13. Nakonechna T., Kachmar R., Gryniv N., Danylovych T. (2019). Modeling of the retail pharmaceutical companies' customers service level // Contemporary issues in economy: abstract book of the 10th International conference on applied economics, 27–28 June 2019, Toruń, Poland, 193., DOI: 10.24136/eep.abs.2019.2

UDC 004.338.47

DOI: <https://doi.org/10.46783/smart-scm/2020-2-8>

JEL Classification: L86, M15, O32, O33.

Received: 30 July 2020

Kopishynska K. O. PhD (Economics), Senior Lecturer of Department of Management, National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" (Ukraine)

ORCID – 0000-0002-1609-2902

Researcher ID –

Scopus author id: 56658753800

CURRENT STATE AND PROSPECTS OF DIGITAL TRANSFORMATION OF THE TRANSPORT AND LOGISTICS SECTOR OF UKRAINE

Kateryna Kopishynska. "Current state and prospects of digital transformation of the transport and logistics sector of Ukraine". The article examines the current state of digital transformation of enterprises in the transport and logistics sector and identifies key prospects for its development. Diagnosis of Ukraine's results in the international rankings, which determine the intensity and direction of use of digital technologies and ICT by countries, found that the country's position on these indicators is average or below average among the studied countries. Analysis of the evaluation of the innovation index of Ukrainian companies for enterprises in the transport and logistics sector revealed that most of the innovations implemented by enterprises relate to digital technologies and ICT. However, these companies are technological market leaders and do not fully reflect the trends of the entire industry. Analysis of the use of ICT in the transport and logistics sector by domestic enterprises showed that in 2019 almost 90% of enterprises use the Internet in their activities, only 22% have their own website, and less than 9% of the total number of enterprises in the sector use cloud computing. In 2020, due to the emergence of coronavirus disease (COVID-19) and the implementation of quarantine measures to prevent its spread, there were significant changes in the functioning of the world economy in general, and the transport and logistics sector in particular. To determine the prospects for the digital transformation of the transport and logistics sector, it was proposed to define them by levels and directions. Four main levels of digital transformation were proposed: microlevel (internal management and business processes of the enterprise), mesolevel (interaction of the enterprise with consumers, clients and partners), macrolevel (interaction of the enterprise with the state and state regulation and management) and megalevel (harmonization with international rules and integration with international infrastructure). Among the most promising areas are proposed the automation of management and production processes, the Internet of Things, artificial intelligence, robotics, last mile delivery, warehouse automation, blockchain, data analysis, cloud computing, autonomous vehicles.

Keywords: digitalization, digital transformation, logistics and transport, innovations, management.

Катерина Копішинська. «Сучасний стан та перспективи цифрової трансформації транспортно-логістичного сектору України». У статті досліджено сучасний стан цифрової трансформації підприємств транспортно-логістичного сектору та визначено ключові перспективи її розвитку. Діагностика результатів України в міжнародних рейтингах, які визначають інтенсивність та напрями використання цифрових технологій та ІКТ країнами встановила, що позиції країни за цими показниками є середніми або нижче середніх серед досліджуваних країн. Аналіз оцінки індексу інновацій українських компаній для підприємств

транспортно-логістичного сектору. виявив, що більшість інновацій, які впроваджують підприємства, відносяться до цифрових технологій та ІКТ. Проте ці підприємства є технологічними лідерами ринку і не відображають повною мірою тенденцій усієї галузі. Аналіз використання вітчизняними підприємствами транспортно-логістичного сектору ІКТ показав, що у 2019 році майже 90 % підприємств використовують Інтернет в діяльності, лише 22 % мають власний сайт, а хмарними обчисленнями користується менше 9% загальної кількості підприємств сектору. У 2020 році внаслідок появи коронавірусної хвороби (COVID-19) та запровадження карантинних заходів щодо запобігання її поширення відбулись істотні зміни у функціонуванні світової економіки в цілому, та транспортно-логістичного сектору зокрема. Для визначення перспектив цифрової трансформації транспортно-логістичного сектору було запропоновано визначати їх за рівнями та напрямками. Було запропоновано чотири основні рівні цифрової трансформації: мікрорівень (внутрішні управлінські та бізнес-процеси підприємства), мезорівень (взаємодія підприємства зі споживачами, клієнтами та партнерами), макрорівень (взаємодія підприємства з державою та державне регулювання і управління) та мегарівень (гармонізація з міжнародними правилами та інтеграція з міжнародною інфраструктурою). Серед найбільш перспективних напрямів обрано автоматизацію управлінських та виробничих процесів, інтернет речей, штучний інтелект, робототехніку, доставки останньої милі, автоматизацію складів, блокчейн, аналізу даних, хмарні обчислення, автономні транспортні засоби.

Ключові слова: цифровізація, цифрова трансформація, логістика та транспорт, інновації, управління.

Екатерина Копишинская. «Текущее состояние и перспективы цифровой трансформации транспортно-логистического сектора Украины». В статье исследовано текущее состояние цифровой трансформации предприятий транспортно-логистического сектора и определены ключевые перспективы ее развития. Диагностика результатов Украины в международных рейтингах, которые определяют интенсивность и направления использования цифровых технологий и ИКТ странами установила, что позиции страны по этим показателям являются средними или ниже средних среди исследуемых стран. Анализ оценки индекса инноваций украинских компаний для предприятий транспортно-логистического сектора показал, что большинство инноваций, которые внедряют предприятия, относятся к цифровым технологиям и ИКТ. Однако эти предприятия являются технологическими лидерами рынка и не отражают в полной мере тенденций всей отрасли. Анализ использования отечественными предприятиями транспортно-логистического сектора ИКТ продемонстрировал, что в 2019 году почти 90% предприятий используют Интернет в деятельности, лишь 22% имеют собственный сайт, а облачными вычислениями пользуется менее 9% общего количества предприятий сектора. В 2020 году в результате появления коронавирусной болезни (COVID-19) и введения карантинных мероприятий по предотвращению ее распространения состоялись существенные изменения в функционировании мировой экономики в целом, и транспортно-логистического сектора в частности. Для определения перспектив цифровой трансформации транспортно-логистического сектора было предложено определять их по уровням и направлениям. Было предложено четыре основных уровня цифровой трансформации: микроуровень (внутренние управленческие и бизнес-процессы предприятия), мезоуровень (взаимодействие предприятия с потребителями, клиентами и партнерами), макроуровень (взаимодействие предприятия с государством и государственное регулирование и управление) и мегауровень (гармонизация с международными правилами и интеграция с международной инфраструктурой). Среди наиболее перспективных направлений предложены автоматизация управленческих и производственных процессов, интернет вещей, искусственный интеллект, робототехника, доставка последней мили, автоматизация складов, блокчейн, анализ данных, облачные вычисления, автономные транспортные средства.

Ключевые слова: цифровизация, цифровая трансформация, логистика и транспорт, инновации, управление.

Introduction. The functioning of enterprises in all spheres of activity in the conditions of constant changes in the external environment, economic crisis and uncertainty on the one hand, it would seem, do not contribute to the intensification of innovation. On the other hand, the active implementation of the latest developments in science and technology can provide the company not only to increase the efficiency of its activities, but also the prospects of market leadership, including technology. The era of digital transformation of society began in the twentieth century and is significantly intensifying every year in the twenty-first century. It can be said that a significant "leap" in this direction occurred in 2020 due to the spread of coronavirus disease (COVID-19), which caused significant restrictions on population mobility and slowing world trade. After all, the lack of "live" communication with partners (clients, contractors) as a result of quarantine measures introduced by many countries has intensified the use of information and communication technologies (ICT), digital technologies and the Internet in management and business processes of almost all enterprises. Enterprises in the transport and logistics sector were no exception to the general trend and were also forced to either start or continue their own digital transformation. How quickly and successfully such transformational changes can be implemented depends on the current state of digitalization of enterprises and their innovation orientation in general, as well as on the ability of management to form long-term strategies for enterprise development in modern conditions.

Analysis of recent research and publications. The issue of digital transformation of the economy in general and the transport and logistics sector in particular is currently quite relevant, so many Ukrainian and foreign scientists, as well as specialized organizations are studying it. Thus, the International Telecommunication Union (ITU) and the IMD World Competitiveness Center

study the use of ICT and digital technologies at the global level and form country rankings on these indicators. PricewaterhouseCoopers has been researching key trends in logistics and transportation for several years, including under the influence of digitalization. Among domestic researchers to the impact of ICT and digital technology in the transport and logistics sector dedicated their work O. I. Nikiforuk, O. M. Stasiuk, L. Yu Chmyrova, N. O., Fediai, S. A. Filatov, L. M. Golovchenko, K.O. Sichkarenko, and others. However, the actual state of ICT use by enterprises in the transport and logistics sector remains insufficiently studied, and the impact of COVID-19 on changes in the digital transformations of the sector needs further clarification.

The purpose and objectives of the study. The purpose of the study is to analyze the current state of digital transformation of transport and logistics activities of enterprises and determine the directions and prospects for its development in Ukraine. To achieve this purpose, the tasks to be solved are identified, namely: to analyze the use of ICT by enterprises of the transport and logistics sector, to determine the features of the sector working in the quarantine restrictions imposed by the spread of COVID-19, and their impact on digital transformation of transport and logistics activities, to suggest directions of perspective development of digitalization of the sector.

Basic material and results. As already mentioned, the use of innovations in the activities of enterprises can significantly improve the results of their operation and become the basis for active development and long-term competitiveness. Digital transformation is inherently innovative. According to the definition of the Concept of development of the digital economy and society of Ukraine for 2018-2020, "digitalization - saturation of the physical world with electronic-digital devices, tools, systems and electronic communication between them, which actually allows integrated interaction of virtual and physical, ie creates cyberphysical space "[1].

Digital transformations of business is the result of digitalization, namely the process that involves the introduction of innovative information and digital technologies and devices in order to optimize and improve the efficiency of activities in general, as well as maximize customer and partner needs. "Mind" and its partners have developed the Innovation Index of Ukrainian companies and evaluated 50 domestic companies from 10 sectors of the economy that are implementing the largest transformations, including the transport and logistics sector. The innovativeness of companies was

evaluated by product characteristics, business processes, business models and customer service [2]. Most of the innovations implemented by companies, including transport and logistics, relate to information and digital technologies. The results of the assessment of the innovativeness of the largest companies in the transport and logistics sector are presented in table. 1. (according to the calculation methodology, the maximum score of the index is 100, but none of the studied industries has received such a result)

Table 1

The innovativeness index assessment of Ukrainian companies "Mind Innovation Index" for enterprises of the transport and logistics sector in 2019

	TOTAL Index	Innovativeness of the product	Innovativeness of the business processes	Innovativeness of the business models	Innovativeness in working with clients
Transport and logistics	80				
Nova Poshta	76	70	78	71	81
Boryspil Airport	55	50	64	48	53
Ukrposhta	54	42	59	48	50
UIA	54	39	64	45	57
Ukrzaliznytsia	40	33	47	27	40

Source: [2]

The leading companies in the transport and logistics sector according to the innovativeness index have implemented the following key innovations, which have also become a significant step in the process of implementing their digital transformation: Nova Poshta - launch of automated sorting terminals; Boryspil Airport - launch of self-check-in and baggage check-in machines; Ukrposhta - business transformation and active implementation of IT solutions in activities; UIA - call center optimization; Ukrzaliznytsia - implementation of a website and a mobile application for buying tickets for passengers, a system of electronic distribution of carriages for freight [2]. To determine the current state of digital

transformation of the transport and logistics sector, it is necessary to form a system of indicators by which it is evaluated, as well as to take into account the general trends of digitalization at the national level. Global research in this area has been conducted for a long time. According to the IMD World Digital Competitiveness Ranking 2019, Ukraine ranked 59-60 in the period 2015-2019 (while the average rankings of 40 countries in Europe-Middle East-Africa show 38-40 positions) [3]. The ICT Development Index for 2012-2017 shows the change in Ukraine's position from 71 in 2012 to 79 in 2017 [4]. However, the authors and developers of this rating decided to clarify and supplement the indicators on which the accounting is carried

out and currently the updated rating has not been submitted. Analyzing the place of Ukraine in the presented ratings of digitalization and ICT implementation, we can determine the level of digital transformation of the country as an average or below average, which should be taken into account when analyzing the digital transformation of each sector of the economy.

The selection and collection of indicators for the analysis of digitalization and development of ICT for each separate field of activity and the country as a whole is the subject of discussions at the international level, and the situation with the delay in publishing the updated ICT Development

Index is additional confirmation. The State Statistics Service of Ukraine collects the information on the use of ICT in the activities of enterprises on a list of indicators, which has many items, but is not exhaustive and does not include, in particular, information on the use of such innovative digital and ICT as the Internet of Things (IoT), Blockchain, Artificial intelligence (AI), Augmented reality (AR), 3D printing, etc. Thus, we analyze the use of ICT by enterprises of the transport and logistics sector on the following selected indicators: the availability of Internet access, the availability of its own website, the use of the website, the use of cloud computing and its directions (Fig. 1-3).

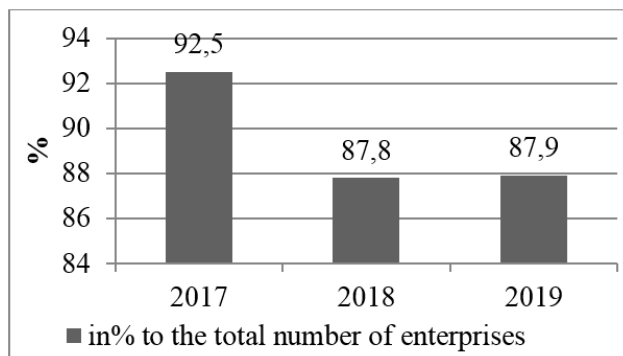


Figure 1a - The share of enterprises in the transport and logistics sector that had access to the Internet

Source: compiled by the author according to the data [5]

According to the data presented in Fig. 1a, we can see that the share of enterprises in the transport and logistics sector that had access to the Internet for the period 2017-2019 is quite high, although there is a tendency to decrease, although the absolute figures, according to statistics, are growing. This may be due to the fact that the growth of the total number of enterprises in this area is growing faster than the process of connecting them to the Internet. One of the indicators of

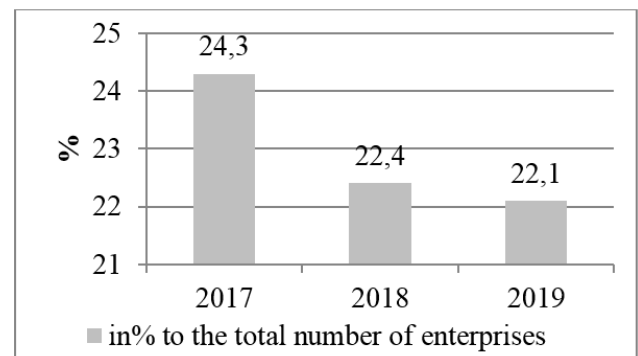


Figure 1b - The share of enterprises in the transport and logistics sector that had a website

the use of ICT in the activities of enterprises is the presence of its own website (Fig. 1b). As you can see, the general trend of a slight decrease in the indicator in the study period persists, which can also be explained by the fact that new companies spend some time developing and launching their own site. It is also advisable to consider in more detail the possibility of providing interactive services that can provide enterprise's own website (Fig. 2).

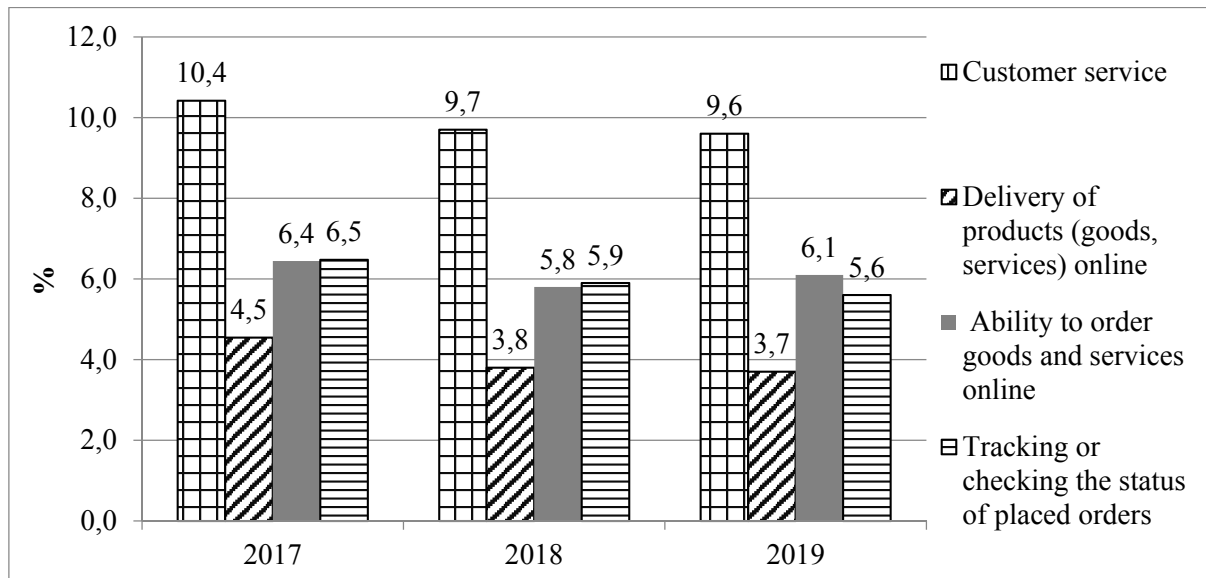


Figure 2 - The share of enterprises of transport and logistics sector, which had a website that provided the possibility of providing interactive services

Source: compiled by the author according to the data [5]

There is a small amount of involvement of the websites of transport and logistics companies in providing opportunities of interactive services. This can be due to many factors, including: reluctance or distrust of customers to use the website as a tool for communication with the company, lack of relevant clear information about communication with the company through the site, Internet outages, mismatch of quality of interactive services through the company's website expectations customers, etc.

The use of cloud computing in the activities of enterprises in the transport and logistics sector allows them to work better and faster, process information and interact with customers. According to statistics on the number of enterprises in the sector that use cloud computing, in 2017 they were 7,9% of

the total number of enterprises, in 2018 – 7,5%, and in 2019 – 8,1%. [5].

As you can see, the number of companies buying cloud computing services is very small and does not exceed 9% of the total number of companies. It is worth noting that some of these services are quite expensive, and small businesses cannot afford them, but the not all companies have the need to use such services. Although the constant deepening of the process of digitalization of the transport and logistics sector will contribute to further growth in the use of cloud computing not only by large enterprises and market leaders, but also by small players, as their cost will decrease and functionality will improve. Fig. 3 presents the structure of the use of cloud computing services.

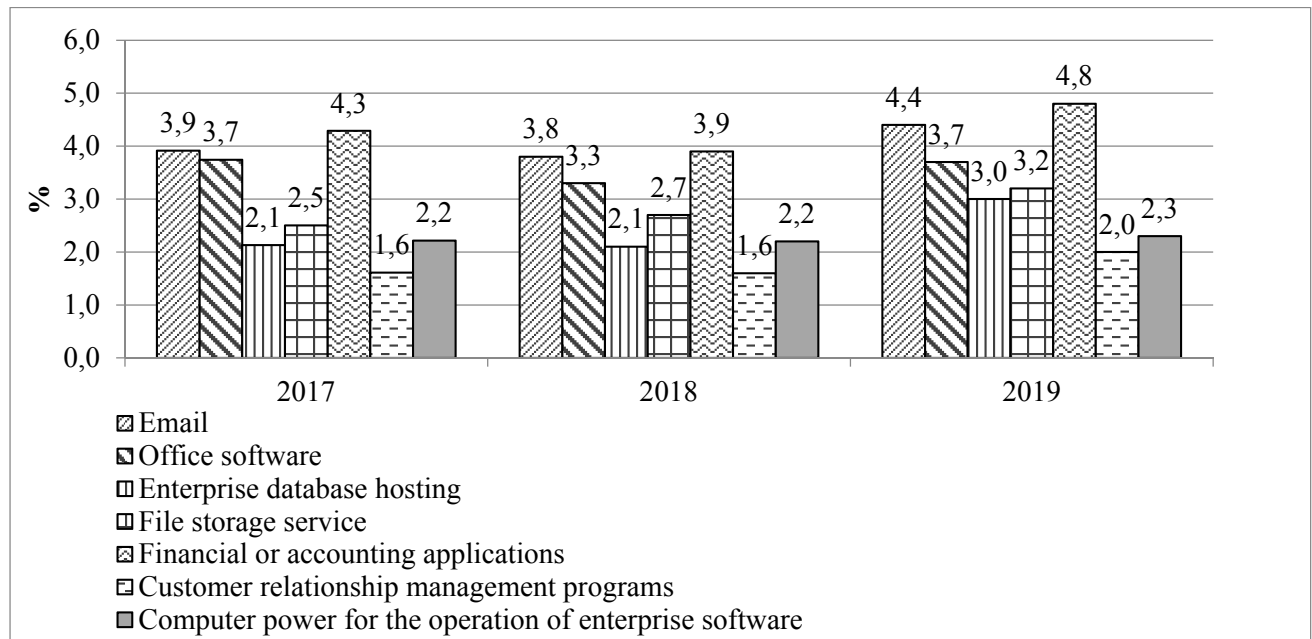


Figure 3 - The share of enterprises of transport and logistics sector which bought cloud computing services by the type of service

Source: compiled by the author according to the data [5]

It is worth noting that the presented trends in the implementation of ICT by enterprises of the transport and logistics sector may undergo significant changes starting in 2020. After all, during the spread of COVID-19 and the implementation of quarantine restrictions in the activities of many enterprises in the sector, significant changes took place. For example, the efficiency of transport and postal and courier companies will differ significantly in all areas, including digital transformation.

Analyzing the structure of the sector and the peculiarities of its work during the quarantine period, it should be noted that the most negative impact was on transport. In the first 6 months of 2020, cargo turnover of transport enterprises amounted to 80,4% of the volume of the same period in 2019. In

2020, transport enterprises transported only 83,7% of cargo from January – June 2019. Transport companies engaged in passenger transportation have suffered much greater losses. Thus, in the first six months of 2020, the turnover of transport enterprises amounted to 80,4% of the volume of the same period in 2019, and the volume of transported goods in January-June 2020 amounted to 83,7% of the volume of the same period in 2019. Transport companies engaged in passenger transportation have suffered even greater losses. In particular, the passenger turnover of transport enterprises in the first half of 2020 amounted to only 44,1% of the corresponding period of 2019, and the number of passengers in January-June 2020 decreased to 56,6% compared to the same period in 2019 [5] (Fig. 4, a, b).

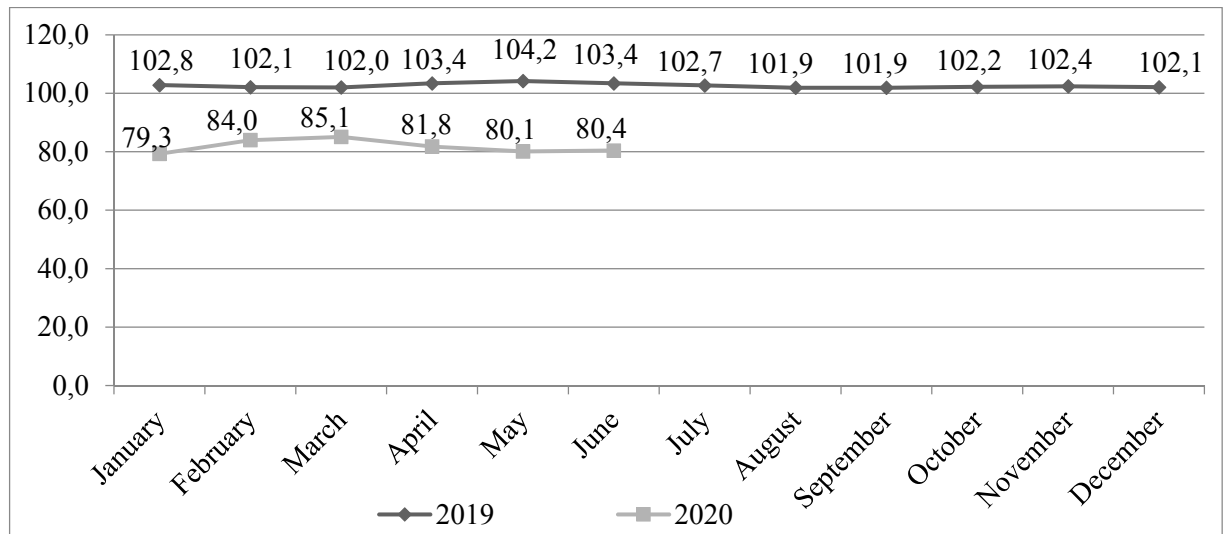


Figure 4a - Freight turnover of transport enterprises, in% to the corresponding period of the previous year, cumulative total

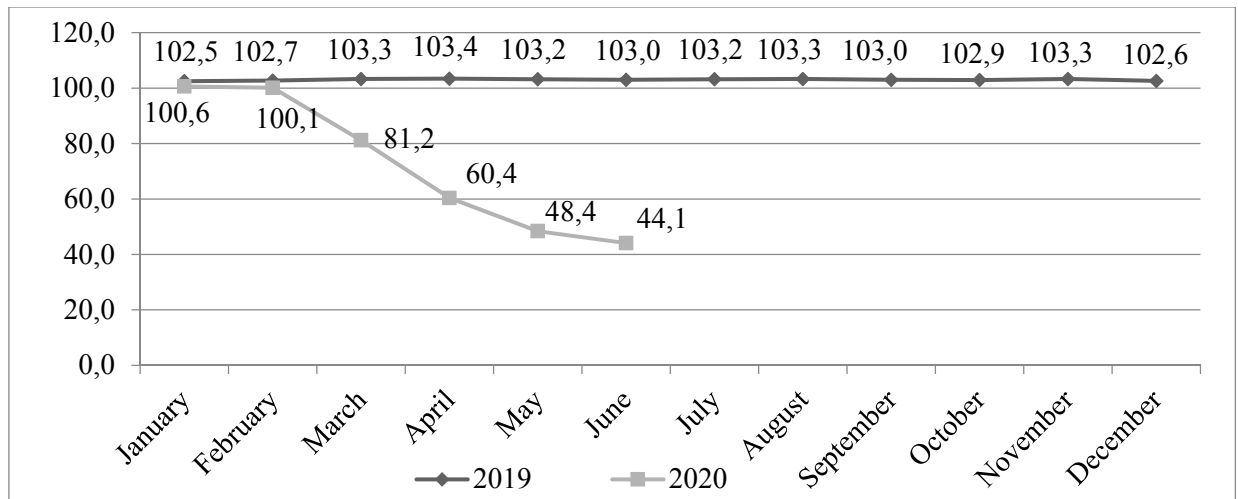


Figure 4b - Passenger turnover of transport enterprises, in% to the corresponding period of the previous year, cumulative total

Source: [5]

The largest decline in transport performance was experienced by air passenger traffic. This trend is global in nature. According to IATA specialists, passenger traffic forecast drop in 2020 is about -51%. At the global level, the decline in passenger and freight traffic is more sharp than the decline in GDP in 2020, and their slow recovery is expected from 2021 [6]. However, it is well known that big crises are the impetus for the development of innovation and transformation of established business models and the crisis of 2020, caused by the spread of the coronavirus disease COVID-19 is no exception. Now it is no longer

a desire, but the need to remove a human from many processes to ensure the safety of his life, becomes the start for the active dissemination and implementation of digital and information and communication technologies. Identification of the trends in the transport and logistics sector under the influence of ICT and digital technologies are presented in many studies, and their general principles are largely the same [7, 8, 9, 10] StartUs Insights has identified 10 trends in logistics that will affect companies in 2020 and beyond in the future (represented by the degree of influence in%): Internet of Things - 17%, Artificial Intelligence - 14%, Robotics -

11%, Last Mile Delivery - 11%, Warehouse Automation - 11%, Blockchain - 10%, Data analytics - 9%, Cloud Computing - 8%, Autonomous Vehicles - 5%, Elastic Logistics - 4% [8]. More than half of these technologies are already beginning to be used by enterprises of the domestic transport and

logistics sector, but the use of some of them requires preparation not only at the micro level, ie at the enterprise level, but also at the national level, ie at the macro level.

Fig. 5 presents the key levels and directions of digital transformation of the transport and logistics sector of Ukraine.

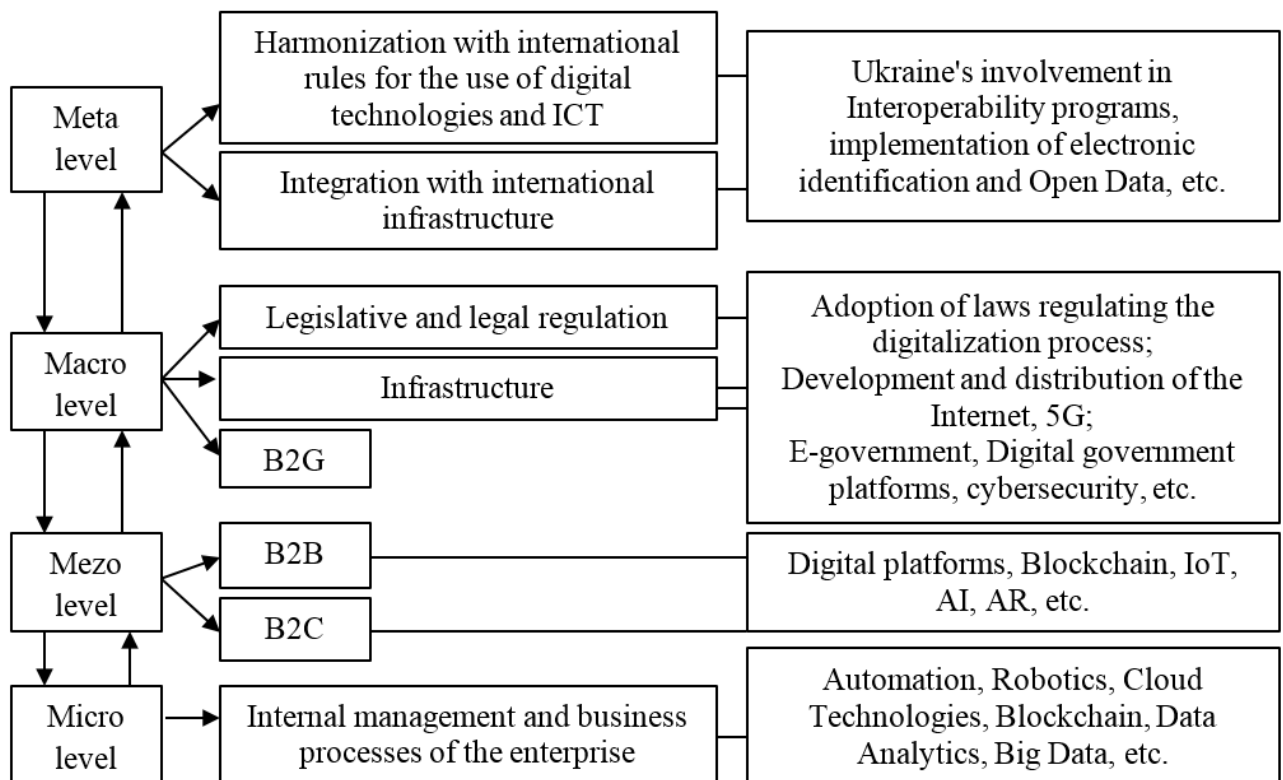


Figure 5 – Levels and directions of digital transformation of the transport and logistics sector
 Source: developed by the author

Digital transformation at the micro level involves changes in the internal business processes of the enterprise, ie ways and means of organizing and managing its activities. Shown in Fig. 5 directions of digital transformation can be used by small enterprises as well as 3PL, 4PL and 5PL operators. Automation can apply to both production and management processes, and can be used by both transport and courier companies and warehousing companies. Digital warehouses, for example, combine technologies such as Automation, Robotics, Cloud Technology, Data Analytics, Blockchain, and so on.

Robotization is also relevant for the domestic transport and logistics sector, in

particular, in the performance of loading and unloading operations, works related to the repair and maintenance of technical means. After all, modern cargo terminals in developed countries have essentially a robotic industry in which using digital programs without direct human participation take place most of these processes [11, 12].

A separate important issue in the process of digital transformation is the analysis and storage of data. Transport and logistics companies usually accumulate a large amount of heterogeneous information in their form, content and source of origin. After processing and analysis, the information is used by management to make management decisions. The larger the company, the larger

the data sets that need to be stored and processed. "Big Data" is used to organize, store, and analyze unstructured information. In today's world, a large number of companies collect extremely large amounts of information about their customers, clients, customers, determine their preferences to form an individualized offer and maximize the level of their satisfaction. Transport and logistics companies collect data from sensors on vehicles, cargo, equipment, portable devices, data on the location of vehicles in real time, information on traffic jams, data from mobile applications, information from shippers and recipients, etc. All this data needs to be stored and processed [13]. Therefore, the use of Big Data and Data Analytics are also becoming necessary components of the digital transformation of the transport and logistics sector.

The interaction of the enterprise with customers, partners and consumers (meso-level of digital transformation) today can take place contactlessly using digital platforms. Examples of such domestic digital platforms in the field of road transport are Degruz, Della, Flagma, Lardi-Trans, which provide a request from the owner of the goods for transportation of goods, and from the owner of the vehicle - for the provision of transportation services. Recognized as the most innovative company in the transport and logistics sector, Nova Poshta has long planned to start delivering parcels using drones, and, taking into account the peculiarities of doing business in quarantine, will probably make every effort to implement the planned as soon as possible.

In recent years, the process of digital transformation at the macro level has intensified significantly. The key principles of digital transformation of Ukraine's economy are set out in two main documents: "Concepts of development of digital economy and society of Ukraine for 2018-2020" [1] and "Digital Agenda of Ukraine - 2020" [14], which define the principles, measures and the plan of implementation digital transformation. However, there is currently no legal

regulation of this process, which significantly complicates the provision of cybersecurity by the state. The opening of the "Electronic Customs" became important for the transport and logistics sector, which significantly simplified and accelerated the border crossing process. Ukrainian e-service of public services "Diia", developed by the Ministry of Digital Transformation, is a mobile application with digital documents and a portal with public services. The digital driver's license allowed users to drive without a physical driver's license, and the patrol police - to check the documents and identity of the driver on an online request to the register. Ukraine has become one of the 10 countries in the world that have introduced such a service. Electronic driver's licenses and electronic vehicle registration certificates are digital versions of documents, not their alternatives [15].

An important issue of the mega-level for the digital transformation of Ukraine is the coordination and harmonization with international rules and regulations on the use of digital technologies and ICT. Among them are the following [14, 16]:

1. Ukraine's accession to the EU Program Interoperability Solutions for European Public Administrations 2 (ISA2), e-CODEX projects, e-Invoicing, as well as the Single Digital Gateway initiative.

2. Implementation of eIDAS regulations in Ukraine, including the introduction of cross-border electronic identification and authentication and accession to the EU project Stork 2.0.

3. Implementation of an electronic interaction system to EU requirements, in particular the European Interoperability Framework 2.0.

4. Implementation of eIDAS regulations in Ukraine, including accession to the EU project Stork 2.0.

5. Integration of the state web portal of open data of Ukraine data.gov.ua into the central European portal of open data europeandataportal.eu and data.europa.eu.

6. Official recognition of all international standards of the Alimentarius Code system, and the standards that form the basis of "Logistics 4.0".

7. Implementation of works on harmonization of "Electronic Customs" documents with EU requirements and introduction of the Single Administrative Document (SAD).

8. Organization of compatibility of the current control system for the movement of goods, which is used in the customs authorities of Ukraine, with the European NCTS [14, 16].

The COVID-19 pandemic has made significant changes in the economic and social life of the world's population. Given the objective need to eliminate a human from as many business processes as possible, the pace of digital transformation will continue to accelerate. Therefore, identifying the directions of such transformations in the transport and logistics sector will allow focusing efforts on specific and promising transformations, and getting the maximum benefits from such changes.

Conclusions. New challenges always create new opportunities. In today's world, digital technologies and ICT, which are used in all areas of economic activity, are becoming increasingly important. The digital transformation of the transport and logistics sector has already begun and is in the process of active transformation. The quarantine restrictions imposed by the spread of coronavirus COVID-19 have become an additional catalyst for these changes. In Ukraine, there are companies that can be called technological leaders in the industry,

which actively use digital technologies and ICT in their activities, have a strategic vision of its prospects and their own digital transformation (Nova Poshta, Ukrposhta, etc.). However, so far there are not so many. Analysis of data on the use of ICT in the transport and logistics sector by enterprises showed that less than 25% of enterprises have their own website, and even fewer use it to provide interactive services. And cloud computing is used by less than 10% of enterprises in the sector. The development of digital infrastructure is gradually turning companies into a contactless mode of interaction with consumers and customers through digital platforms. There are significant changes in the process of digital transformation at the macro level. Thus, since 2019, the Ministry of Digital Transformation has been established and is actively functioning in Ukraine, which was created for this purpose. The benefits of using some of the results of its activities (e-service of public services "Diia") could already be felt by transport companies. But important issues that have not yet been resolved by the state are the legislative regulation of digital transformation, as well as the harmonization of updated rules and standards with international rules and regulations for the use of digital technologies and ICT. As for the directions of digital transformation of the transport and logistics sector of Ukraine, they correspond to global trends, i.e. the use in the Automation of Management and Production processes, the Internet of Things, Artificial Intelligence, Robotics, Last Mile Delivery, Warehouse Automation, Blockchain, Data Analytics, Cloud Computing, Autonomous vehicles.

References

1. Pro skhvalennia Kontseptsii rozvytku tsyfrovoy ekonomiky ta suspilstva Ukrainy na 2018–2020 roky ta zatverdzhennia planu zakhodiv shchodo yii realizatsii: Rozporiadzhennia Kabinetu Ministriv Ukrainy vid 17.01.2018 r. № 67-r. URL: <http://zakon.rada.gov.ua/laws/show/67-2018-%D1%80>

2. Mind Innovation Index 2019: shtuchnyi intelekt, ale piratskyi soft. Mind – veb-sait. URL: <https://mind.ua/publications/20203121-mind-innovation-index-2019-shtuchnij-intelekt-ale-piratskij-soft>
3. IMD World Digital Competitiveness Ranking 2019. URL: <https://www.imd.org/wcc/world-competitiveness-center-rankings/world-digital-competitiveness-rankings-2019/>
4. Measuring the Information Society Reports (2014, 2015, 2017). URL: <https://www.itu.int/en>
5. Ofitsiyni sait Derzhavnoi sluzhby statystyky Ukrainy. URL: <http://www.ukrstat.gov.ua/>
6. Transport and logistics barometer H1 2020. PwC. URL: <https://www.pwc.de/de/transport-und-logistik/transport-and-logistics-barometer-h1-2020.pdf>
7. Shifting patterns: The future of the logistics industry.(2016). PwC's future in sight series. 20 p. URL: <http://www.pwc.com/futureinsight>
8. Top 10 Logistics Industry Trends & Innovations: 2020 & Beyond. URL: <https://www.startus-insights.com/innovators-guide/logistics-industry-trends-10-innovations-that-will-impact-logistics-companies-in-2020-beyond/>
9. Hausmann L., Wölfel T., Stoffels J., Fleck O. Startup funding in logistics New money for an old industry? McKinsey & Company. Travel, Transport & Logistics, February 2020. 21p.
10. Top 10 Supply Chain and Logistics Technology Trends in 2020. Transmetrics: web-site. URL: <https://transmetrics.eu/blog/supply-chain-logistics-technology-trends/>
11. Nykyforuk O. I., Stasiuk O. M., Chmyrova L. Yu., Fediai N. O. Tsyfrovizatsiia v transportnomu sektori: tendentsii ta indykatory rozvytku. Chastyna 1. Statystyka Ukrainy, 2019. № 3. S. 70-81.
12. Sichkarenko K. O. Vplyv tsyfrovizatsii ekonomiky na rozvytok transportnoi haluzi. Prychornomorski ekonomichni studii. Vypusk 38-1. 2019. S. 76-79.
13. Kopishynska K. O. Vykorystannia ozer danykh yak skladova tsyfrovoy transformatsii transportno-lohistychnykh kompanii. Biznes, innovatsii, menedzhment: problemy ta perspektyvy: I mizhnar. nauk.-prakt. konf., Kyiv, 23 kvitnia 2020 r.: tezy dopovidei. K.: IVTs Vydavnytstva "Politekhnik", 2020. S. 212.
14. Tsyfrova adzhenda Ukrainy – 2020. URL: [https:// ucci.org.ua/uploads/files/58e78ee3c3922.pdf](https://ucci.org.ua/uploads/files/58e78ee3c3922.pdf)
15. Diia (servis). Vikipediia – veb-sait. URL: <https://uk.wikipedia.org>
16. Filatov S. A., Holovchenko L. M. Vplyv tsyfrovyykh tekhnolohii na efektyvnist ta rozvytok ahrolohistyky v Ukraini. Vcheni zapysky Universytetu «KROK», 2018. – Vypusk 49. S. 151-160.

UDC 004.9:005:347.763:625.08
JEL Classification: K33, L91, Q57, R50.
Received: 30 July 2020

DOI: <https://doi.org/10.46783/smart-scm/2020-2-9>

Hryhorak M. Yu. Doctor of Science in Economics, Associate Professor, Head of Logistics Department of National Aviation University (Ukraine)

ORCID – 0000-0002-5023-8602
Researcher ID –
Scopus author id: 57208222758

Karpenko O.O., Doctor of Science in Economics, Professor, Professor by Water Transport Management and Economics Department, State University of Infrastructure and Technologies (Ukraine)

ORCID – 0000-0003-2943-1982
Researcher ID –
Scopus author id: -

Semeriahina M. M., Senior Lecturer of Logistics Department of National Aviation University (Ukraine)

ORCID – 0000-0001-7490-6874
Researcher ID – S-7158-2018
Scopus author id: -

CURRENT STATE AND PROSPECTS OF DIGITAL TRANSFORMATION OF THE TRANSPORT AND LOGISTICS SECTOR OF UKRAINE

Mariia Hryhorak, Oksana Karpenko, Myroslava Semeriahina. *"Formation of the multimodal transportation ecosystem in Ukraine".* The article is devoted to the problem of formation of multimodal transport ecosystem in Ukraine and reveals features of mutual relations of participants of the logistic service market in the digital economy conditions. In the process of the study, the fragmentary and multi-vector nature of the existing regulatory and legal support of logistics activities in Ukraine, freight forwarding and transportation of goods by different modes of transport were determined. The conclusion is made about the need for legislative support of multimodal transportation, taking into account environmental requirements and current trends in the digitalization of the logistics business to ensure the delivery of goods "door to door". The necessity of an ecosystem approach to the development of the concept of multimodal transport development and ensuring the partnership of market participants in order to create an integrated multimodal service is proved. The structure of the multimodal transport ecosystem in Ukraine is proposed, which provides the possibility of vertical and horizontal interaction of market participants, standardization of logistics processes, unification of cargo batches and automation of procedures related to document management in a single information system. Based on statistical analysis, the main problems and opportunities for the development of multimodal transport in Ukraine have been identified. It is concluded that the removal of existing barriers can

be a powerful stimulus to improve the quality of multimodal logistics services and will realize the transit potential of Ukraine.

Keywords: business ecosystem, logistics services market, multimodal freight transport, multimodal logistics service, regulatory and legal regulation of logistics activities, potential of the national logistics system.

Марія Григорак, Оксана Карпенко, Мирослава Семерягіна. «Формування екосистеми мультимодальних перевезень в Україні». Стаття присвячена проблемі формування екосистеми мультимодальних перевезень в Україні і розкриває особливості взаємовідносин учасників ринку логістичних послуг в умовах цифрової економіки. В ході проведеного дослідження встановлено фрагментарність та різновекторність наявного нормативно-правового забезпечення логістичної діяльності в Україні, експедирування та перевезень вантажів різними видами транспорту. Зроблено висновок про необхідність законодавчого забезпечення мультимодальних перевезень з урахуванням екологічних вимог та сучасних трендів цифровізації логістичного бізнесу для забезпечення доставки вантажів «від дверей до дверей». Доведено необхідність екосистемного підходу до розроблення концепції розвитку мультимодальних перевезень та забезпечення партнерства учасників ринку з метою створення інтегрованого мультимодального сервісу. Запропоновано структуру екосистеми мультимодальних перевезень в Україні, яка забезпечує можливість вертикальної та горизонтальної взаємодії учасників ринку, стандартизації логістичних процесів, уніфікації вантажних партій та автоматизації процедур, пов'язаних з документооборотом в єдиній інформаційній системі. На основі статистичного аналізу визначено основні проблеми та можливості розвитку мультимодальних перевезень в Україні. Зроблено висновок, що усунення наявних бар'єрів може стати потужним стимулом для підвищення якості мультимодального логістичного сервісу та дозволить реалізувати транзитний потенціал України.

Ключові слова: бізнес-екосистема, ринок логістичних послуг, мультимодальні вантажні перевезення, мультимодальний логістичний сервіс, нормативно-правове регулювання логістичної діяльності, потенціал національної логістичної системи.

Мария Григорак, Оксана Карпенко, Мирослава Семерягина. «Формирование экосистемы мультимодальных перевозок в Украине». Статья посвящена проблеме формирования экосистемы мультимодальных перевозок в Украине и раскрывает особенности взаимоотношений участников рынка логистических услуг в условиях цифровой экономики. В ходе проведенного исследования установлено фрагментарность и разновекторность имеющегося нормативно-правового обеспечения логистической деятельности в Украине, экспедирувания и перевозки грузов разными видами транспорта. Сделан вывод о необходимости законодательного обеспечения мультимодальных перевозок с учетом экологических требований и современных трендов цифровизации логистического бизнеса для обеспечения доставки грузов «от двери до двери». Доказана необходимость экосистемного подхода к разработке концепции развития мультимодальных перевозок и обеспечения партнерства участников рынка с целью создания интегрированного мультимодального сервиса. Предложена структура экосистемы мультимодальных перевозок в Украине, которая обеспечивает возможность вертикальной и горизонтальной взаимодействия участников рынка, стандартизации логистических процессов, унификации грузовых партий и автоматизации процедур, связанных с документооборотом в единой информационной системе. На основе статистического анализа определены основные проблемы и возможности развития мультимодальных перевозок в Украине. Сделан вывод, что устранение имеющихся барьеров может стать мощным стимулом для повышения качества мультимодального логистического сервиса и позволит реализовать транзитный потенциал Украины.

Ключевые слова: бизнес-экосистема, рынок логистических услуг, мультимодальные грузовые перевозки, мультимодальный логистический сервис, нормативно-правовое регулирование логистической деятельности, потенциал национальной логистической системы.

Introduction. The global trend of the world economy is digitalization, which has a transformational impact on business in general, and the market of logistics services in particular. Digital technologies create unique opportunities for open communications and widespread collaboration of market participants and are a powerful catalyst for institutional change, enabling logistics companies to implement new business models and offer customers new services and logistics services. A recently published study [1] has used the term "FreightTech", which refers to the use of artificial intelligence, automation and integration technologies, which together revolutionize the logistics industry, and more. They change the processes of transportation and transshipment of goods, cargo handling and storage of goods, order processing and supply chain management. The growth of investment in FreightTech start-ups indicates the formation of intelligent clusters and transportation ecosystems (FreightTech ecosystem). Interviews of Roland Berger Economic experts with participants in the European freight market have revealed its strong fragmentation and multi-vector regulation of the current regulatory framework. Different policies of EU governments mean that logistics providers find it difficult to standardize processes, including cabotage rules and electronic document formats. This interferes the digitization of businesses. Large freight forwarders are investing heavily in the development of digital technologies, but smaller market players lack the funds to adapt their business models and they are losing market share. It is necessary to create regulatory legal prerequisites for digitalization of logistics business and identify data generation and processing real time for balanced development of the logistics service market and ensuring high-quality accomplishment of requirements of cargo owners (logistics service consumers) on the principles of "Door to Door" and "Just in Time".

On the other hand, climate change and enhancement of environmental problems actualize the issue of finding optimal logistics solutions aimed at reducing the harmful effects on the environment. The principles of "green" logistics and closed-loop supply chains require a comprehensive approach to solving social, economic and environmental problems of the national economy. This is manifested in the implementation of the sustainable development concepts of the country and the prioritization of logistics solutions aimed at reducing harmful emissions and the use of more environmentally friendly modes of transport for the movement of goods both within the country and internationally. In this context, a special role belongs to the search for optimal multimodal schemes for transportation of goods and the development of incentives for their use. In accordance with the signed Association Agreement between the European Union and Ukraine, European norms and rules are being implemented in Ukraine, as well as the harmonization of various regulatory legal acts, including the regulation of transport development. However, the current regulatory and legal framework does not create sufficient conditions for efficient logistics and lags behind the real needs of the market environment. This is especially true of stimulating the development of multimodal transport and their legal regulation in the context of digitalization of the economy.

Thus, all this determines the relevance of the study of international experience in regulating the multimodal transport market in the context of reducing environmental impact, defining the conceptual prerequisites for creating an ecosystem of multimodal transport in Ukraine in accordance with the latest trends in logistics, and research of prospects for multimodal technologies through a prism of logistical service.

Analysis of recent research and publications. Legal regulation of the multimodal transportation development as a separate segment of the logistics service

market is considered in the scientific literature in fragments. According to scientific study [2] it was determined that the key functions of multimodal transport management are the offer of services of multimodal transport, management of multimodal transport systems and the development of new types of services. In accordance with these functions, key competencies and the roles of market participants have been defined. The authors of the scientific article [3] drew attention to the rethinking of traditional logistics services through the prism of intermodality and reviewed the methods of planning intermodal freight. The role and dynamics of the introduction of modern information and communication technologies in the field of multimodal transport in the EU have been studied in scientific article [4]. Scientific works [5-7] focus on environmental problems of transport and comparative analysis of costs and harmful emissions of multimodal technologies in comparison with road transport. The authors of the scientific article [8] have proved that container transportation is an effective way to reduce the carbon footprint, and also proposed a system of indicators and a model for evaluating the synergistic effect degree of reducing harmful emissions. The proposed system of indicators was further developed in the scientific article [9], which studied the role of rail transport in multimodal transport.

Many researchers pay attention to the role of multimodal transport for efficient supply chain management and justify the necessity to create an integrated multimodal transport network. This is crucial for companies to successfully implement processes in their supply chains both domestically and internationally. A new meta-model of the general intermodal transport network is proposed by the authors in a scientific article [10]. For operative decision-making, the model presents a detailed structure of the intermodal transport network and predicts its dynamic development with the help of modern information and communication technologies. The necessity

for interaction of different types of transport and integration of multimodal transport participants has been proved in many scientific publications. In particular, the scientific article [10] presents a theoretical approach related to transport and logistics clusters, identifies the main factors to increase their competitiveness in the regions of functioning. Transport multimodal nodes as the core of logistics clusters are able to solve both the task of coordinating the work of participants in the transport process within the existing transport system, and the task of modernizing the transport system and implementing innovations. In particular, leading Ukrainian scientists have studied the possibility of forming transport and logistics clusters in seaports [12] or airports [13]. Analysis of different points of view allows us to conclude that the main feature of the transport and logistics cluster is the concentration of a group of interdependent enterprises, organizations and companies in a given area, which provides competitive advantages of the regions.

The generalization of the latest trends in logistics development allows us to conclude about the growing role of business partnerships, the key to the success of which is the mutual use of resources and capacity with a synergistic effect of interaction of partner organizations. The new organizational form of partnership economic agents is ecosystem. The term "business ecosystem" was first proposed by J. Moore [14] in 1993. He has proposed to consider the company not as a participant in any one industry, but as a component of the business ecosystem, whose members "co-develop" around new innovations, collaborating and competitively supporting new products to meet customer needs. Deloitte published a thorough report "Business ecosystems come of age" in 2014 [11]. This report identifies that ecosystems are dynamic communities of diverse actors evolving together, creating and capturing new value through better models of simultaneous collaboration and competition.

The ecosystem approach is becoming increasingly popular in research because it reflects the real transformations of business configurations of logistics entities, is based on the relationship and interdependence of logistics service production, environmental processes, human environment and thus integrating the economy, ecology and social processes of society. In a broad sense, the ecosystem approach is the methodological basis of many areas in science and practice. This provides an opportunity through the study of socio-natural integrity to determine its general changes in any effects on its components, its genesis with all the connections of components and objects, as well as to predict not only direct but also indirect effects of human impact on natural environment objects [15, p. 56]. In the context of our study, the principle thesis is the transition from static models of logistics systems to self-organizing systems. If the static system can be regulated only by the top, namely by the state's influence on organizations and institutions, the ecosystem has its own market mechanisms of self-development, meaning it is adjusted from below. This creates prerequisites for continuous innovation processes, eliminating excessive state intervention. The ecosystem approach draws attention to not so much on the participants of the system as the nature and dynamics of their interactions (with each other and with potential participants), emphasizing that the collaboration is seen as a horizontal and network environment for communication between all sectors and organizations. This ensures the creation and diffusion of knowledge flows, the transformation of these flows into innovations and the further spread of innovation throughout the economy. Logistics systems, built on the principles of three-pair interaction of the state, business and science, contain similar matrices of the triple spiral at the level of regions and production sectors. Similarly, manufacturing sectors built on a matrix of links can have regional, national and supranational scales,

i.e. grow to macro-regional and global ones. The concept of the triple spiral shows that the way out of the technological trap and overcoming the dependence on the previous vector of development is not in the gradual improvement of the technology itself, but in the improvement of the communication environment where it is used. This means that structural reforms that are in line with global economic trends need to be pursued, rather than simply borrowing advanced production technologies. Also, a comprehensive study of American scientific and technological societies "Future Knowledge Ecosystems" emphasizes that the new type of government should develop horizontal links, intercluster interactions and mechanisms for combining the resources of the territory with global markets [16].

The purpose and objectives of the study. The purpose of the study is to substantiate the feasibility of using an ecosystem approach for the multimodal transport development in Ukraine as a specific segment of the logistics service market, as well as to identify issues and ways to develop a multimodal logistics service. To achieve this goal, the following tasks are defined:

1) analysis of the existing regulatory and legal regulation of logistics activities and determining the direction of its improvement in order to development of the multimodal logistics service;

2) substantiation of feasibility of the ecosystem approach to formation of the concept of multimodal transport development and definition of structure of this ecosystem;

3) Identification of problematic issues and barriers which restrain the multimodal transport development in Ukraine and suggestion of ways to solve them.

Basic material and results. Generalizations of different points of experts' views on the processes taking place in the economy of Ukraine suggest that today its socio-economic life is governed by an eclectic mix of market mechanisms and archaic social

institutions, which were only partially adapted to new economic conditions. The need, on the one hand, the evolutionary transition from one economic mode to another one, and on the other hand, adaptation to a new paradigm of economic development (information, network, knowledge economy), greatly complicates the management processes of economic systems at different levels. This requires a clear understanding of the specifics of economic relations between businesses and authorities, and thus actualizes the organic relationship between technological innovation and the institutional environment. Ukraine is redefining the path and strategy of economic development in accordance with Association Agreement between the European Union and Ukraine. Paradigmatic transformational changes in the system of national economy are reflected in the system of the national economy management. This involves a radical change of macro-regulatory agencies, monitoring of the state of the economy and individual markets, regional and sectoral regulation, and regulation and monitoring of economic entities and their associations. The systemic stability of the national economy must be ensured by the stability of the subject core (state), the

balance of the internal structure of each subject (state, region, enterprise) and the systemic relationships between them.

Unfortunately, in Ukraine the existing regulatory and legal framework does not create sufficient conditions for efficient logistics and lags behind the real needs of the market environment. There are a large number of law regulatory acts that regulate only certain issues and procedures related to freight forwarding, customs and insurance. There is no word "logistics" in any current law regulatory act and, accordingly, the state does not create legal prerequisites for the effective implementation of concepts and tools of logistics in the activities of domestic businesses and so on. Certainly, the national legislation on logistics should define the mechanisms of state regulation, management and control in the field of logistics, entities, legal and organizational framework for logistics, the rights and obligations of the client and the business entity, contractual obligations in the provision of logistics services etc.

The analysis of the existing regulatory and legal support of logistics activities in Ukraine was allowed to identify the basic laws and codes presented in Table 1.

Table 1

Laws and Codes of Ukraine governing logistics activities

No.	Number and date of approval	Name and brief description
1.	Code on May 19, 2011, No. 3393-VI	Air Code of Ukraine. It establishes the legal framework for aviation activities and is aimed at ensuring aviation safety, ensuring the interests of the state, national security and the needs of society and the economy in air transport and aerial application.
2.	Code on May 23, 1995, No. 176/95-BP	The Merchant Shipping Code of Ukraine. It regulates the relations arising from merchant shipping, namely during activities related to the use of ships for the carriage of goods, passengers, luggage and mail, fishing and other marine fisheries, exploration and mining, towing, icebreaking and rescue operations, cable laying, as well as for other economic, scientific and cultural purposes.
3.	Law of Ukraine on December 23, 2004, No. 2286-IV	On Certified Warehouses and Ordinary and Twofold Warehouse Certificates. It regulates legal relations related to the registration, issuance, redemption of simple and twofold warehouse certificates, determines the procedure for their registration and aims to create legal, economic, organizational conditions for the

No.	Number and date of approval	Name and brief description
		operation of these documents during storage of goods in warehouses.
4.	Law of Ukraine on November 10, 1994, No. 232/94-BP	On Transport. It defines the legal, economic, organizational and social foundations of transport.
5.	Law of Ukraine on July 04, 1996, No. 273/96-BP	On Railway Transport. It defines the basic legal, economic and organizational principles of public railway transport, its role in the economy and social sphere of Ukraine. It regulates the relations of railway transport with executive authorities, local governments, other modes of transport, passengers, senders and consignees of cargo, baggage and mail, taking into account the specifics of the functioning of this mode of transport as a single production and technological complex.
6.	Law of Ukraine on April 05, 2001, No. 2344-III	On Road Transport. It defines the principles of organization and operation of road transport.
7.	Law of Ukraine on October 20, 1999, No. 1172-XIV	On Transit of Cargoes. It determines the principles of organization and transit of goods by air, road, rail, sea and river transport through the territory of Ukraine.
8.	Law of Ukraine on April 06, 2000, No. 1644-III	On Transportation of Dangerous Cargoes. It defines the legal, organizational, social and economic principles of activities related to the transport of dangerous goods by rail, sea, river, road and air transport.
9.	Law of Ukraine on July 01, 2004, No. 1955-IV	On Forwarding Activity. It defines the legal and organizational principles of forwarding activities in Ukraine and aims to create conditions for its development and improvement.
10.	Law of Ukraine on October 04, 2001, No. 2759-III	On Postal Service. It determines the legal, socio-economic and organizational basis of activities in the field of postal services, as well as regulates relations between public authorities and local governments, postal operators and users of their services.

Source: compiled by the authors according to the data [17]

Separate normative acts regulate the rules of passenger and cargo transportation, in particular:

- Rules of transportation by rail;
- Rules of air transportation of cargoes;
- Rules of cargo transportation by road in Ukraine;
- Rules for the carriage of goods in a direct mixed rail-water service.

Taking into account the considered regulatory and legal support the main aspects of logistic activity regulation is presented in general on Fig. 1, where we define the three main levels of regulation: international, national and level of enterprise.

It should be noted that Association Agreement between the European Union and

Ukraine encourages market participants in logistics services to implement in practice the EU regulations and directives on the formation of a single European transport area and reduce the harmful impact of the sector on the environment. The conceptual basis for EU regulation of logistics activities are summarized on Fig. 2.

Thus, the analysis of the contradictions of the existing legal acts concerning the activity of transport and the conceptual bases of the European logistics require adequate changes in the regulation of the logistics activity in Ukraine. One such act should be the Law on Multimodal Transportation, the draft of which is currently submitted to the Verkhovna Rada.

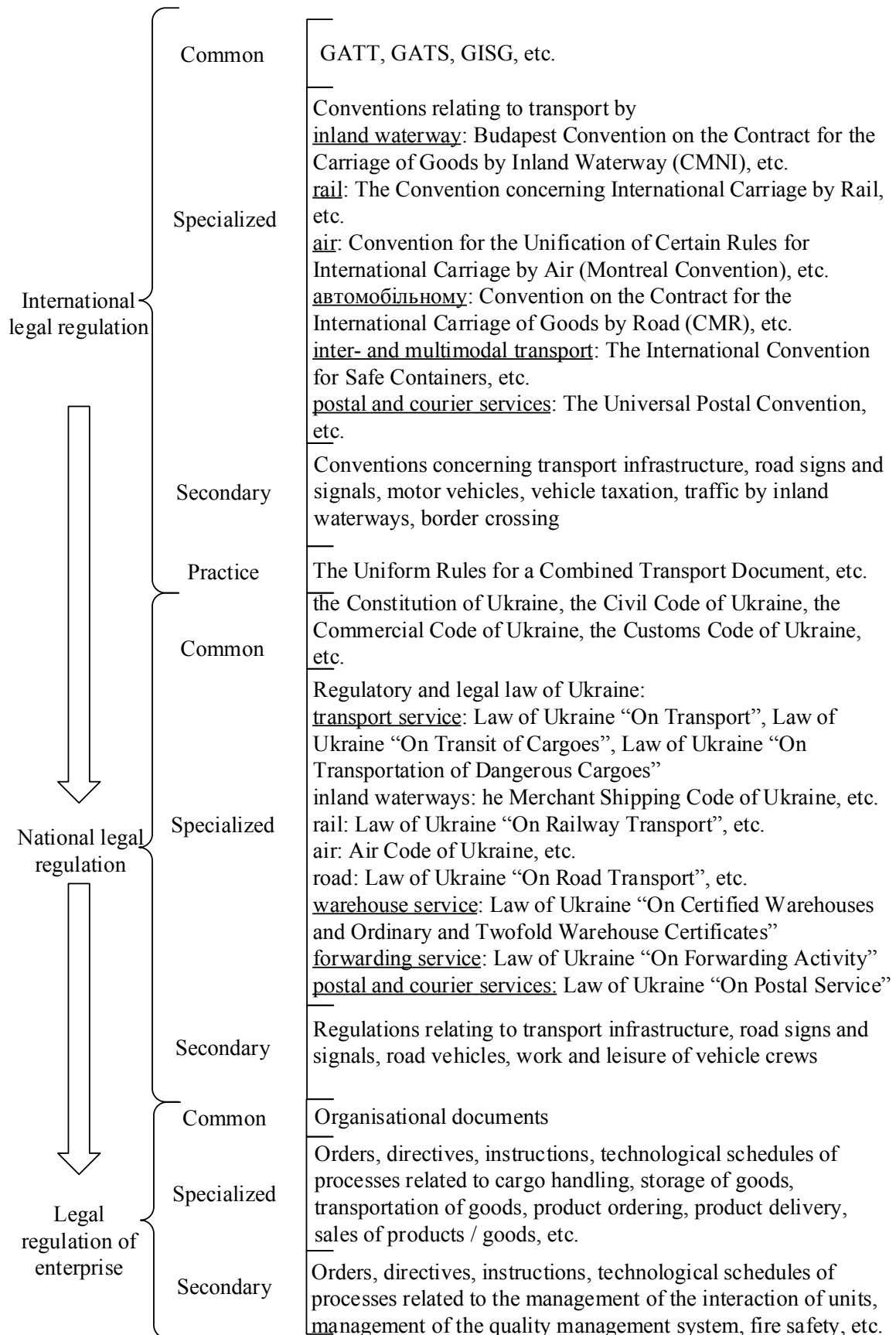


Figure 1 – Generalized scheme of legal regulation of logistics activity in Ukraine
 Source: compiled by the authors according to the data [17]

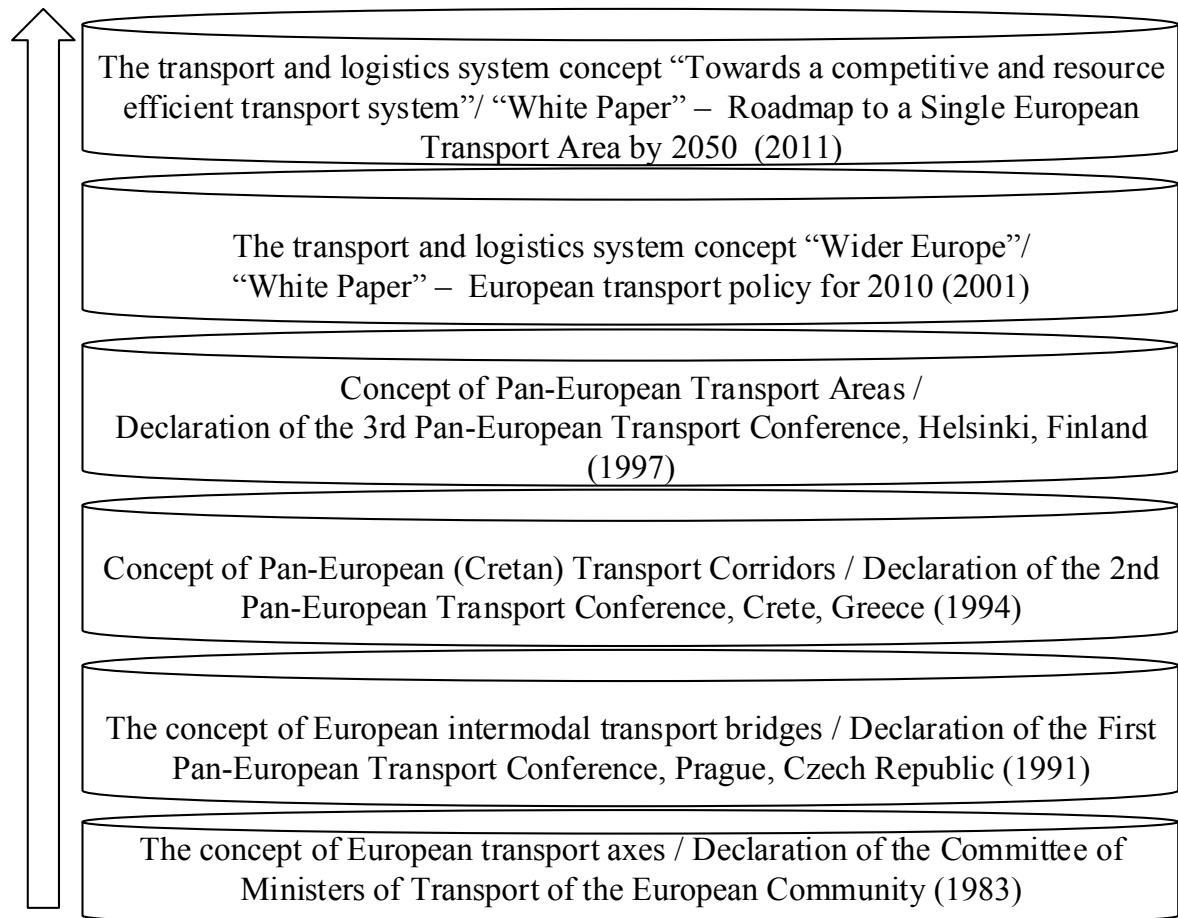


Figure 2 – Conceptual basis of European regulation of logistics activities

Source: compiled by the authors according to the data [18]

The draft law provides for the implementation of Council Directive 92/106 / EU of 7 December 1992 on the establishment of common rules for certain types of combined transport of goods between Member States. Despite some discussion about the content of the draft law most participants in the logistics service market note its positive role in the introduction of new technologies for freight transportation. The concept of multimodal transport development in Ukraine, which will contribute to the successful implementation of the future law is presented on Fig. 3.

Thus, the presented concept includes all the main stakeholders of multimodal transport and provides for the achievement of the state goal both in terms of European integration and environmental provisions, in addition, takes into account the economic positions of business entities, and provides a single information space for rapid information

interchange and cargo tracking. An important component of the proposed concept for the multimodal transport development is the definition of strategic imperatives as defining requirements for the throughput capability of multimodal networks. In the framework of our study, such provisions are:

- economic growth, especially budget-generating and export-oriented sectors of the economy;
- ensuring security of supply chains and mobility of the population;
- human capital development;
- reduction of harmful emissions from logistics activities;
- saving natural resources through recycling, effective public administration, technological dynamism and innovation.

Given the importance of the Law on Multimodal Transport for the development of the logistics services market, we believe that the initiative to improve the regulation of the

industry and the transport technologies development should be taken by business.

It can be developed a plan of measures needed to implement the concept of multimodal transport by finding a compromise between state institutions responsible for national and public security and the logistics business, which is interested in developing new delivery routes of goods, creating modern multimodal terminals. The key to mutual success, in our deep opinion, will be the creation of an ecosystem of multimodal transportation based on a digital platform.

In the ecosystem approach, managerial influences represent a set of unique non-cyclical solutions that form the concept of ecosystem development. The interaction of ecosystem participants with each other in the external environment is built in three ways: through partnership in an explicit form, secretly in a parasitic form and indirectly through network interconnections. The general structure of the multimodal transport ecosystem in Ukraine is presented on Fig. 4.

The process must be the same for all participants in order for ecosystem participants to be able to interact with each other in digital format. The same essence should be perceived in the only way by any participant of the system without additional steps such as special harmonization of terms, common understanding of documents and data analysis. For this approach to work, it is necessary to create and maintain a data model that will be accepted by all participants in the ecosystem. Standardization, unification and automation of logistics processes, information and technological evolution create preconditions for the formation and development of networks that enable intersectoral and international cooperation, as well as accelerate the creation of horizontal

and vertical partnerships within the chain of consumer value.

Intelligent logistics systems should work in real time in a single coordinate system and a single information space and thus create a methodological basis for optimizing logistics solutions and better use of existing logistics infrastructure. At the same time, they should contain not only modules of intelligent transport systems, intelligent technologies for monitoring vehicles and traffic flows, but also integrated software solutions for the interaction of enterprises in supply chains. The digital transformation of the logistics services market should be ensured with the help of information technologies for the implementation of multimodal transport on the principles of "Just in Time", "Door to Door" and "Just in Sequence". The main tools for the integration of freight and information flows should be unified protocols, documentation standards and interchange data systems, remote data access systems and mobile management.

Digital transformation of multimodal transport and, as a consequence, logistics service, requires concentration of investment resources on the development of transport and digital infrastructure.

Thus, we have noted the conceptual principles and directions of development of the logistics service market and the creation of the multimodal freight transport ecosystem in Ukraine. Let us consider the practical aspects and problems that currently have to be solved by state institutions in determining the roadmap of the implementation of the multimodal transport development concept. To do this, the statistics will be analyzed and the main trends associated with the use of different modes of transport in the national economy will be identified.

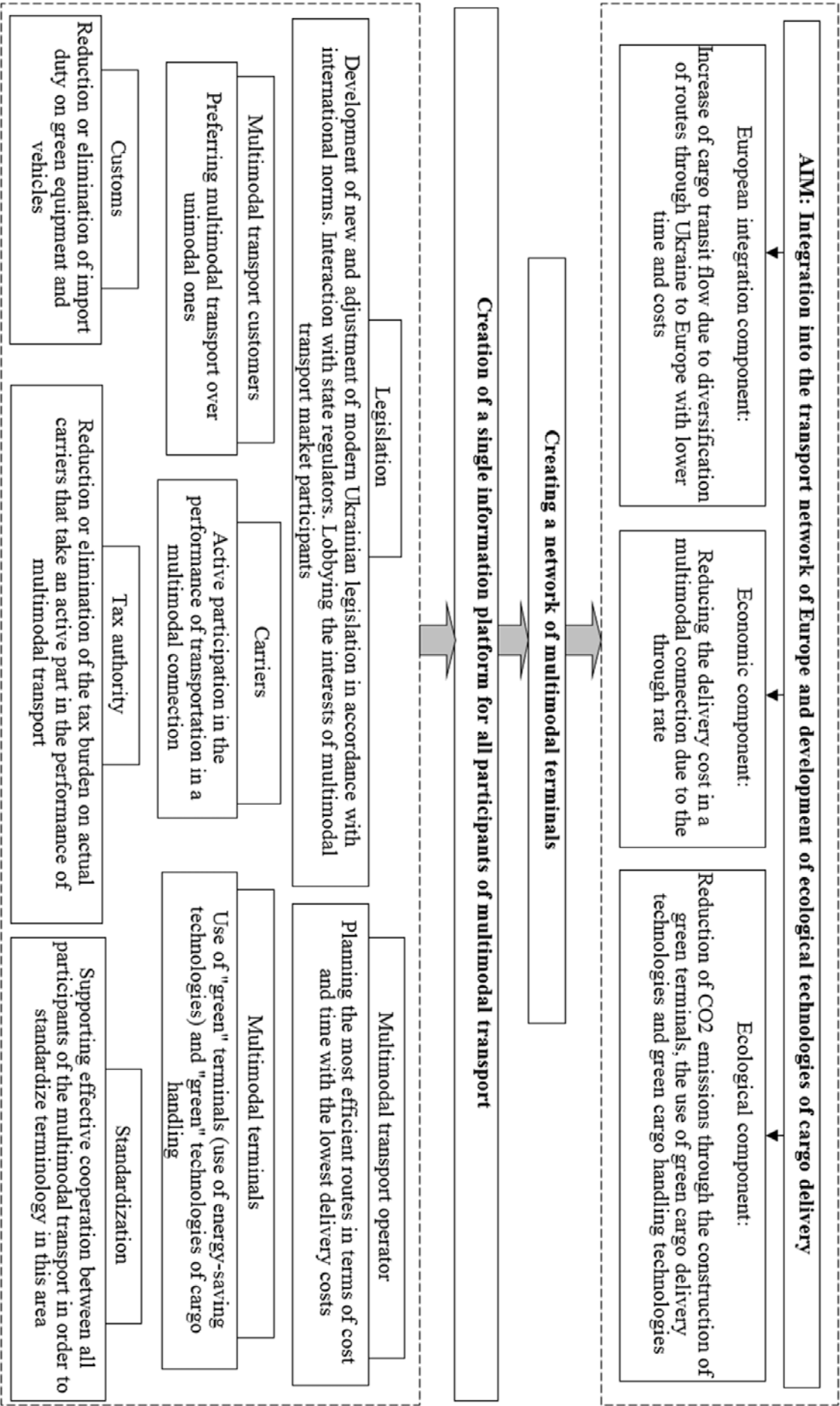


Figure 3 – Concept of multimodal transport development in Ukraine
Source: developed by the authors

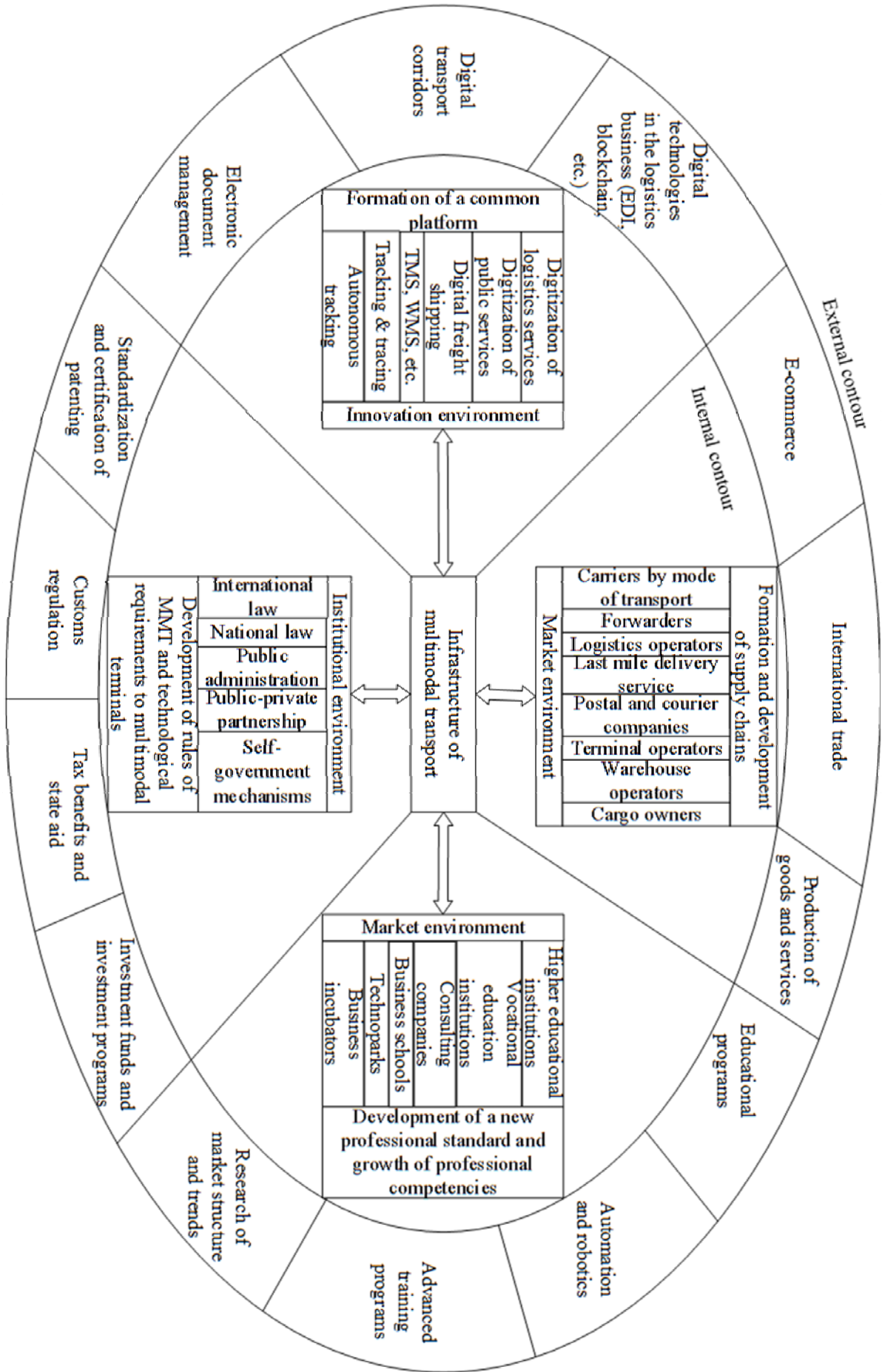


Figure 4 – Structure of the multimodal transport ecosystem in Ukraine
Source: developed by the authors

Let's analyze the main problems of multimodal transport development in Ukraine.

1) The growth of disparities between modes of transport.

According to the State Statistics Service of Ukraine on the volume of freight traffic in Ukraine, a sample was made for those modes of transport that should participate in the development of multimodal transport (excluding air and pipeline transport). The results are presented in Table 2 and 3.

The calculations show that the share of rail transport in the total volume of transported goods over the past 6 years has been steadily declining and reached 312.9 million tons in 2019, i.e. it was 21% of the total volume of transported goods by four modes of transport. For comparison: rail transport transported 514 million tons of cargo in 2007 and only 312.9 million tons were transported in 2019.

Table 2

Statistical data on the volume of cargo transportation by different modes of transport (thousand tons)

Mode of transport	2014	2015	2016	2017	2018	2019	% 2019/2018
Railway	386277	349995	343434	339551	322342	312939	97,08
Sea	2805	3292	3033	2253	1892	2120	112,05
River	3145	3156	3642	3640	3698	3990	107,90
Road	113131 3	102060 4	108566 3	112167 4	120553 1	114705 0	95,15
Total*	152353 9	137704 6	143577 1	146711 7	153346 3	146609 9	95,61

* excluding air and pipeline transport

Source: compiled by the authors according to the data [19]

Table 3

The share of each mode of transport in total* (%)

Mode of transport	2014	2015	2016	2017	2018	2019	Absolute deviation 2019 to 2018
Railway	25,35	25,42	23,92	23,14	21,02	21,35	0,32
Sea	0,18	0,24	0,21	0,15	0,12	0,14	0,02
River	0,21	0,23	0,25	0,25	0,24	0,27	0,03
Road	74,26	74,12	75,62	76,45	78,61	78,24	-0,38

* excluding air and pipeline transport

Source: calculated on the basis of data [19]

On the contrary, the share of road transport in the volume of transported goods increased to 78% in 2019. The share of river transport remains at 0.2-0.3%. So, the total decline in UZ cargo transportation for the year amounted to -2.9% or -9.4 million tons. During the same period, road traffic decreased by 5%.

2) Mismatch in export-import trade flows.

The economic success of any country depends on its trade, and this is not surprising, because trade is one of the leading

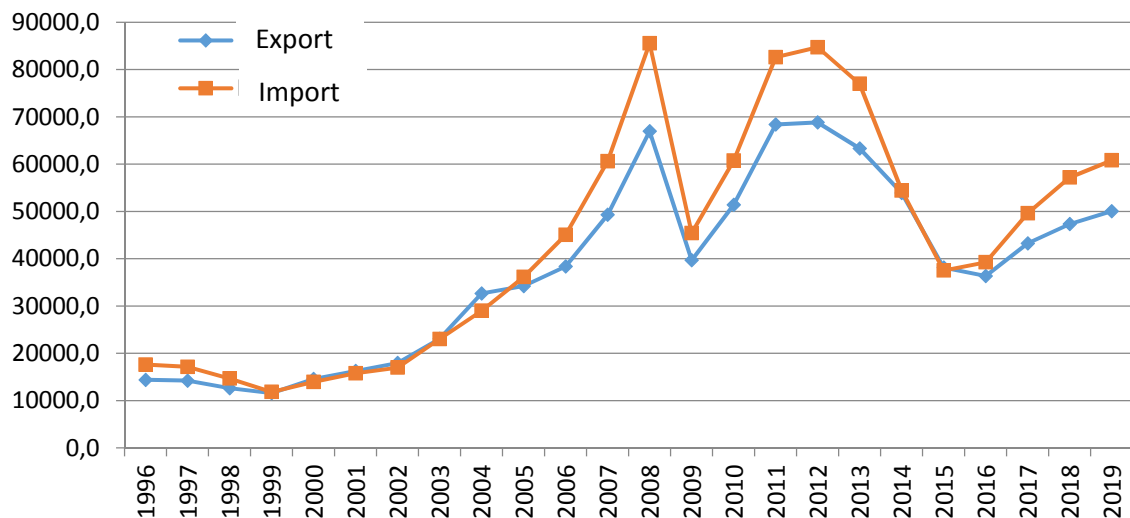
places in terms of impact on economic development. International trade overcomes the narrowness of the market, limited resources, increases the possibility of introducing new technologies and provides an opportunity to use the country's resources more efficiently.

The dynamics of imports and exports of goods and services of Ukraine for 1996-2019 are presented on Fig.5.

According to statistics for the last five years, imports in most cases prevail over

exports, while the negative balance of foreign trade has increased over the past two years, which is considered a rather bad trend in world practice. These data indicate a significant imbalance and a significant advantage of imports over exports, as well as significant fluctuations in volumes depending on the economic situation in the country.

Ukraine's main trading partners in 2018 and 2019 were 212 countries, the main of which are: China, Poland, Italy, Turkey, Germany, India, Hungary, Belarus, Russia, USA, France, Czech Republic, Sweden, Switzerland, Austria.



* Since 2014, excluding the temporarily occupied territory of the Autonomous Republic of Crimea, the city of Sevastopol and part of the temporarily occupied territories in Donetsk and Luhansk regions

Figure 5 – Dynamics of exports and imports of goods and services in Ukraine (million USD)
 Source: compiled by the authors according to the data [19]

Thus, after the loss of one of the largest trading partners, the vector of Ukraine's foreign trade relations changed. If earlier a significant part of export-import operations accounted for the Russian Federation, then after the restructuring of foreign trade guidelines, Ukraine got a chance to deepen trade relations with the European Union and Europe as a whole.

Ukraine belongs to the countries with raw material potential, ie it exports raw materials abroad, and there they process and return them to us in the form of finished imported goods, which is extremely inefficient. The key items of Ukrainian exports are still goods with a low level of processing or low added value, which indicates the extremely inefficient use of natural resources.

Thus, in 2019, the structure of exports was dominated by products of plant origin i.e. agricultural products (wheat, corn, canola), their part was 25.8%. In second place are base metals and articles thereof (mainly ferrous metals and semi-finished products), their part was 20.5%. Fats and oils of animal or vegetable origin (mainly sunflower oil) accounted for 9.5% of total exports, and mineral products (mainly iron ore) were 9.7%. Almost all products are transported in bulk or in bulk.

The largest net importers of agricultural products are the European Union, Russia, Japan, China, South Korea, Saudi Arabia, Algeria, the United Arab Emirates (UAE) and Venezuela.

In the structure of imports in 2019, machinery, equipment and mechanisms

accounted for 21.9%, oil and petroleum products were 20%, mineral products were 12.3%, land vehicles were 10.1%. Most of these products are imported to Ukraine in containers.

3) Low container traffic.

The main trend in the development of domestic and world transport is the rapid growth of container traffic, which provides increased safety of goods, significantly accelerates transshipment and delivery, increases the competitiveness and environmental friendliness of transport products.

The operator of combined transportation on the railways of Ukraine is Branch "Center of Transport Service "Liski"" of the Joint Stock Company "Ukrainian Railways", which owns terminals in Kiev, Dnepropetrovsk, Donetsk, Kharkov, Lugansk, Odessa, Chop and provides comprehensive freight forwarding services, using the benefits of combined.

Currently, Ukrzaliznytsia has organized the container trains and combined transport trains in the direction of international transport corridors, as well as the territory of Ukraine (Fig.6).

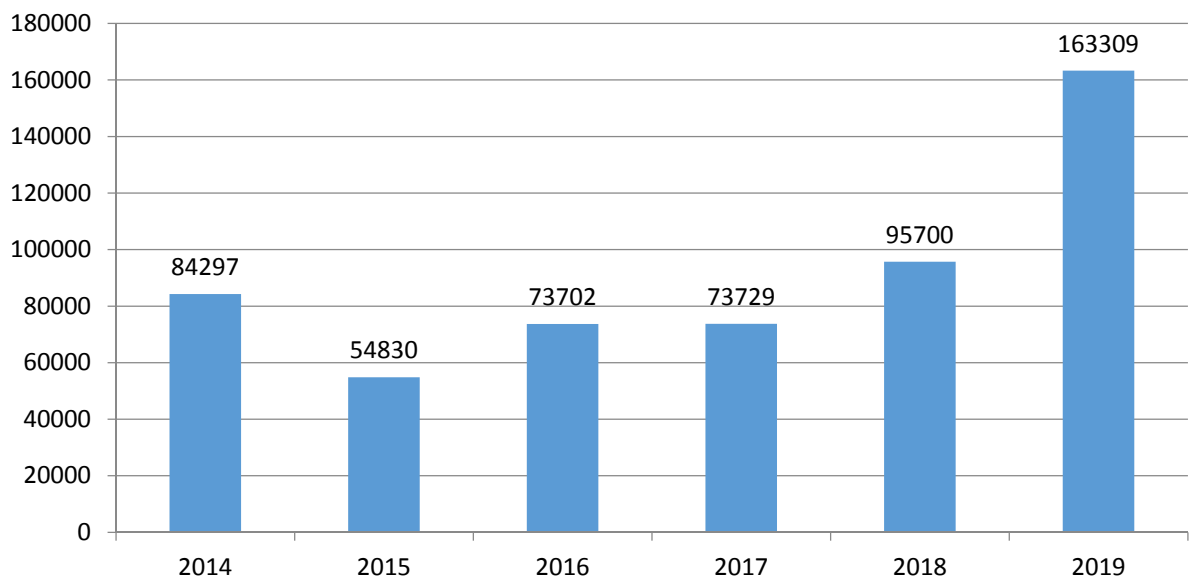


Figure 6 – Total containers as a part of container trains

Source: compiled by the authors according to the data [20]

In total, 163,309 containers were transported in 2019 in conventional units, which is 71% more than in 2018. The largest increase was observed in domestic destinations: in particular, on the route "Kyiv-Liski - Odessa-port" the volume of transported containers increased 4.8 times compared to 2018, it increased 3.9 times respectively on the route "Kharkiv-Liski - Black Sea", it increased in 3 times on the route "Dnipro-Liski - Odessa-port", it increased in 2.7 times on the route "Ternopil - Black Sea", it increased in 4.2

times on the route "Odessa-port - Kharkiv-Liski".

Statistical data on the dynamics of container turnover in seaports of Ukraine for 16 years are presented Fig. 7. The structure of container handling in ports of Ukraine for 2019 is presented in Table 4.

In 2019, the number of containers handled at Ukrainian terminals exceeded 1,007 million TEU mark. Transportations through Ukrainian ports are carried out by 15 shipping companies. 14 companies carry out transportation to the Odessa seaport, 2

companies (Maersk and MSC) carry to the Black Sea fishing port and only Maersk carries

to the port "Pivdennyi". In general, this is a very positive trend.

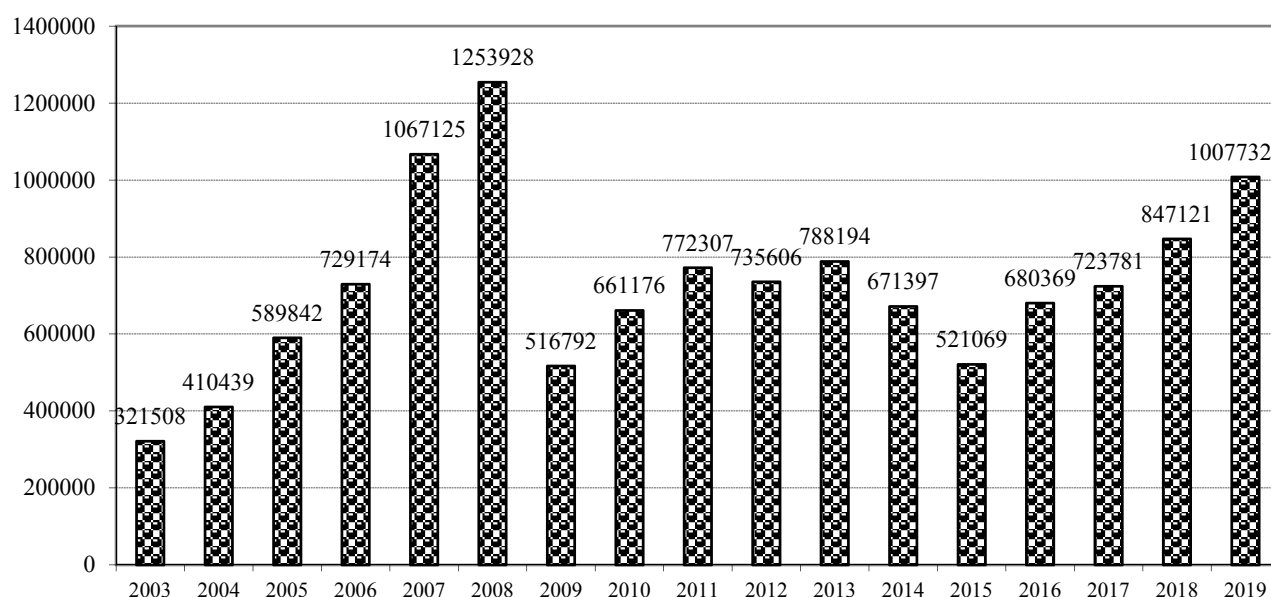


Figure 7 – Dynamics of container turnover in seaports of Ukraine, TEU

Source: [21]

Table 4

Structure of container processing in seaports of Ukraine, TEU

Ports	Import			Export			Total	% before 2018
	Loaded	Empty	Total	Loaded	Empty	Total		
Odessa ICC, including	301152	32794	333946	234068	81408	315476	649422	108,5
Container Terminal Odessa	186578	14805	201383	134948	55109	190057	391440	115,8
Brooklyn-Kyiv Port	114574	17989	132563	99120	26299	125419	257982	99,0
MP Southern (TIS CT)	84087	27621	111708	94873	12079	106952	218660	175,0
Black Sea fishing port	48913	10779	59692	57439	22358	79797	139489	113,3
Total	434152	71194	505346	386380	115845	502225	1007732*	119,0

* incl. 159 TEU handled into SMP "Olbia" and 2 TEU handled in the port of Reni

Source: [21]

In the structure of container flows passing through Ukrainian ports, a balance remains between imports (50.1%) and exports (49.9%). In 2019, in terms of the number of loaded containers (820532 TEU), Ukrainian ports exceeded the peak indicators of 2008 (728416

TEU). Traditionally, the share of loaded containers is higher in imports than in exports. That is more loaded than imported than sent for export. Last year, loaded 434,152 TEU were imported to Ukraine, 386,380 TEU were exported. The growth rate of loaded

containers in imports is slightly higher than in exports: 19.4% and 16.3%, respectively. As for empty containers, their volumes are also growing, but empty containers are more sent from Ukraine (115845 TEU, + 34.6%) than imported (71194 TEU, + 9.7%). The share of empty in the total container turnover is 18.6%.

The highest growth rates in 2019 were demonstrated by TIS KT. A significant role in this was played by the transition to the terminal from the Odessa port of the direct Maersk service. MEZ, in addition to the direct Maersk ECUMED service that is already coming to TIS KK. And also the launch of a new weekly Maersk feeder service connecting the terminal with the Georgian port of Poti, which included Ukraine in the route of the Europe-Caucasus-Asia transport corridor (TRASECA). The TIS KT container terminal has become the

only one in Ukraine that operates in transshipment mode today.

Container trains are one of the most developing logistics areas of TIS. Together with Maersk and Ukraziliznytsya, regular routes were organized in the direction of the Dnieper, Kiev, Kharkov, Ternopil, Chernigov. Today, TIS weekly sends 15 regular trainees.

In the port of Odessa, within the framework of the development of intermodal transportation, 14 regular container trains run in the directions: Kiev, Dnieper, Kharkov, Vinnitsa, Rozhnatov, Verkhnedneprovsk and others. In 2010, only 15% of containers were shipped from the Odessa port by rail. Today almost a third of all containers are handled in the port. The rest are transported by road.

The analysis of container traffic on the Dnieper River is shown in Fig. 8.

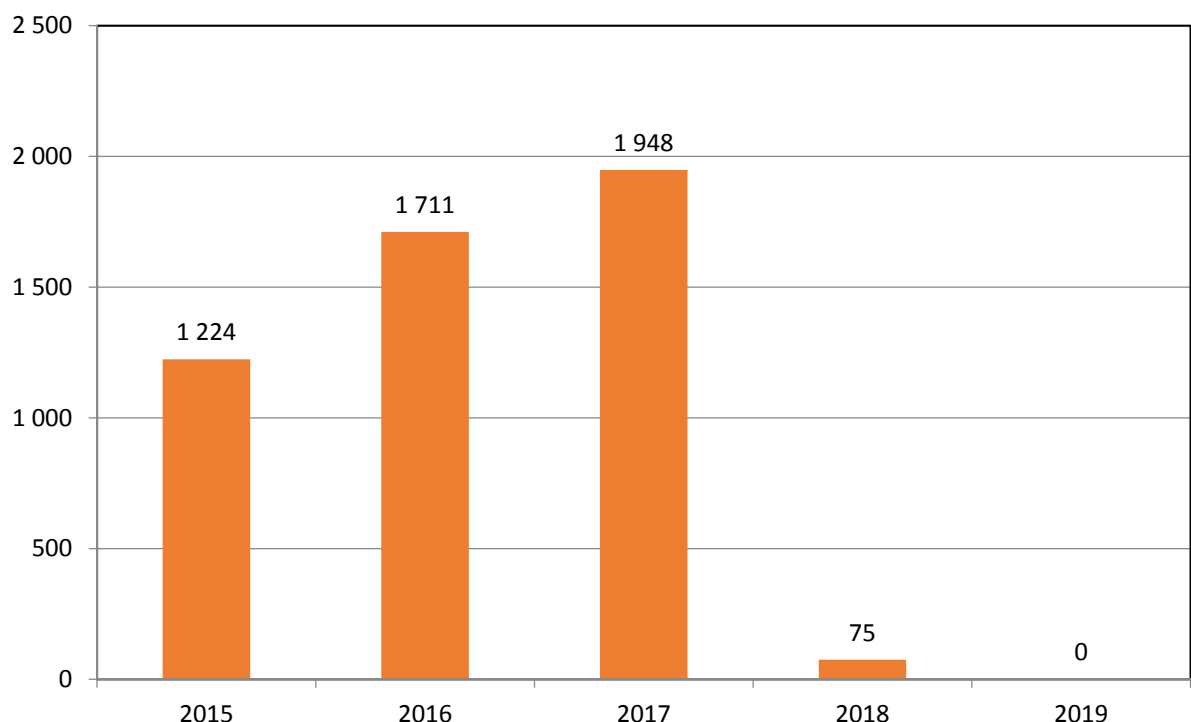


Figure 8 – Dynamics of container traffic on the Dnieper River, units

Source: [22]

Unfortunately, in 2019, no one container was transported along the Dnieper River.

The development of multimodal transportation in Ukraine should take place on the basis of elimination of departmental

and technological fragmentation of railways, ports, road and river transport.

In addition, it is necessary to implement measures for the development of multimodal transport in Ukraine:

- providing state support and economic incentives for the development of multimodal transport;
- implementation of a single position on the formation of the tariff policy of Ukrzaliznytsia and commercial seaports of Ukraine, including the application of a through tariff;
- developing container logistics and improving transport service.

Conclusions. In the process of the study, the problems and prospects of multimodal logistics service development in the conditions of digital economy were determined.

1. Based on the analysis of international and Ukrainian legislation, a conclusion was made about the fragmentary and multi-vector nature of existing regulations, which creates organizational, economic and technological barriers to the widespread implementation of multimodal transport with using cleaner modes of transport and the creation of integrated logistics services of cargo delivery on the principles of "Door to Door" and "Just in Time". Using the mechanisms of implementation of European directives and harmonization of existing laws with the requirements of the European Union to reduce emissions, it was substantiated the feasibility of using an ecosystem approach to developing a concept for multimodal transport in Ukraine, which should stimulate market participants to taking part in stimulation innovation and development of transport infrastructure.

2. It is proved that the ecosystem allows to better understand how the logistics service industry is regulated. Its use to create a regulatory and legal framework takes into account the influence of the state and market mechanisms of self-development and self-regulation and increases competence in the field of logistics. The interaction of participants in the multimodal freight transport ecosystem is seen as a horizontal and network environment for communication between all sectors and organizations, provides the creation and diffusion of knowledge flows, transforming these flows into innovation and further spreading of innovations throughout the economy. All these together improve the quality of the integrated multimodal logistics service and the degree of customer satisfaction.

3. Analysis of statistical data on the status and dynamics of multimodal transport in Ukraine allowed to identify disparities between the use of different modes of transport and between export and import freight flows and the low level of intermodality and unification of freight units. That is why the multimodal transport development in Ukraine should be based on the elimination of departmental and technological fragmentation of railways, ports, road and river transport. It was also concluded that the need for state support and economic stimulus for the multimodal transport development, as well as a set of measures for the formation of a network of multimodal terminals, containerization of cargo flows and improvement of multimodal service.

References

1. FreightTech. Advancing the future of logistics. FreightTech White Paper 2020. Roland Berger and TIMOCOM. 34 p. URL: <https://www.timocom.co.uk/freighttech2020>. [access: 01.08.2020]
2. Ngamvichaikit A. (2017) The Competency Development of Multimodal Transportation Management for Logistics Professional in Thailand// International Journal of Trade, Economics and Finance. 2017. Vol. 8. No. 1. P. 88-103. DOI:10.18178/ijtef.2017.8.1.540.

3. Caris A., Macharis C., Janssens G. K. (2008) Planning Problems in Intermodal Freight Transport: Accomplishments and Prospects // *Transportation Planning and Technology*. Vol. 31 (3). 2008. P. 277-302. DOI:10.1080/03081060802086397.
4. Harris I., Wang Y., Wang H. (2015) ICT in multimodal transport and technological trends: Unleashing potential for the future // *International Journal of Production Economics*. 2015. Vol. 159. P. 88-103. DOI:10.1016/j.ijpe.2014.09.005
5. Chen W., Cao C., Fang X., Kang Z. Expanding the theory of planned behaviour to reveal urban residents' pro-environment travel behaviour// *Atmosphere*. 2019, Vol. 10(8):467. P. 1-21. DOI: 10.3390/atmos10080467.
6. Agamez-Arias A., Moyano-Fuentes J. (2017) Intermodal transport in freight distribution: A literature review// *Transport Reviews*. 2017, Vol. 37. P. 782-807. DOI:10.1080/01441647.2017.1297868.
7. Craig A.J., Blanco E.E., Sheffi Y. (2013) Estimating the CO2 intensity of intermodal freight transportation// *Transportation Research Part D: Transport and Environment*. 2013. Vol. 22. P. 49-53. DOI:10.1016/j.trd.2013.02.016.
8. Fang X., Zhang Ji, Chen Zю, Weiya Chen, Chao Cao, Jinrong Gan (2020) Synergy Degree Evaluation of Container Multimodal Transport System, Sustainability//*MDPI, Open Access Journal*, Vol. 12(4). P. 1-26.
9. Xiaoping Fang, Chao Cao, Zhiya Chen, Weiya Chen, Linglin Ni, Zhang Ji, Jinrong Gan (2019) Using mixed methods to design service quality evaluation indicator system of railway container multimodal transport //*Science Progress* (IF 1.906) Pub Date : 2019-12-05 , DOI: 10.1177/0036850419890491.
10. Boschian V., Dotoli M., Fanti M.P., Iacobellis G., Ukovich W. (2011) A Metamodelling Approach to the Management of Intermodal Transportation Networks// *Proceedings of the 3rd International Workshop on Intelligent Vehicle Controls & Intelligent Transportation Systems*. 2009. P. 96-105.
11. Verduzco-Garza T., Gonzalez Aleu F. (2017) Increasing competitiveness through a logistics and transportation cluster: A Literature Review // *Proceedings of the International Conference on Industrial Engineering and Operations Management*. 2017. P. 384-395.
12. Karpenko O.O. Innovatsiyno-intehratsiyna paradyhma rozvytku pidpryyemstv na pryntsyakh klasteryzatsiyi: monohrafiya //K.: TOV "SIK HRUP Ukrainy". – 2013.
13. Hryhorak M., Savchenko L. (red.), Lohistychni kontseptsii rozvytku aeroportiv, Sik Hrup Ukrainy, Kyiv, 2017, 384 s.
14. Business ecosystems come of age // Deloitte. 2014. – 120 p. URL: https://www2.deloitte.com/content/dam/insights/us/articles/platform-strategy-new-level-business-trends/DUP_1048-Business-ecosystems-come-of-age_MASTER_FINAL.pdf. [access: 03.08.2020]
15. Veklich O. A. Sushchnost' i sodержaniye kontsepta "ekosistemnyy podkhod" v ekonomicheskoy nauke. Nauchnyy zhurnal "Ekonomika Ukrainy". 2017. № 12 (665). S. 52-67.
16. Townsend A. (2009). *Future Knowledge Ecosystems. The Next Twenty Years of Technology-Led Economic Development*. CA: Institute for the Future. 64 p.
17. Main page of "Legislation of Ukraine". URL: <https://zakon.rada.gov.ua/laws/main/index?lang=en>. [access: 04.08.2020]

18. Main page of European strategies. European Commission. URL: https://ec.europa.eu/transport/themes/strategies_en. [access: 04.08.2020].
19. Official site of State Statistics Service of Ukraine URL: <http://www.ukrstat.gov.ua/>. [access: 24.07.2020].
20. Official site of Liski, Center of Transport Service. URL: <http://www.liski.ua>. [access: 24.07.2020].
21. Ports of Ukraine magazine, №2 (194) March 2020.
22. Official site of the Ukrainian Sea Ports Authority (USPA) URL: <http://uspa.gov.ua/en/>. [access: 24.07.2020].

The History of Science

THE SCIENTIFIC CONTRIBUTION OF LEONID BORISOVICH MIROTIM TO THE DEVELOPMENT OF THE LOGISTICS THEORY IN THE POST-SOVIET SPACE

(Devoted to the 85th anniversary from birthday)



Abstract. Leonid Borysovykh Mirotim – the Doctor of Technical Sciences, Professor, Honored Scientist of the Russian Federation, Chairman of the Coordination Council for Logistics, President of the National Council for Supply Chains, current member of the International Academy of Engineering, Academician of the Russian Academy of Natural Sciences, member of the Editorial Council of the scientific journal "Transport Bulletin". In the 80s of the last century, he was one of the first in the USSR who began to conduct research in the field of logistics and publish publications, creating the basis for the scientific school formation in this direction. While working at Moscow Automobile and Highway State Technical University, Professor Mirotim consistently carried out his scientific activities in three areas: production location, transport processes technologies and transport logistics. Leonid Borysovykh trained 16

doctors of sciences as a consultant and supervised 127 candidates of technical and economic sciences. More than 100 theses were opposed by him in various scientific councils of the country. He has written and published over 70 monographs, textbooks and tutorials, published more than 1500 articles in professional journals.

The historical process of the new scientific direction formation is complex and contradictory enough, and its result is largely determined by the sequence of the step-by-step evolution of the knowledge system. Researchers play a particularly important role in the development and systematization of both methods and scientific knowledge itself, since they have a love of learning new things and a desire to generalize and formulate new knowledge. Such a researcher in logistics is Leonid Borysovykh Mirotim, a person who has a systemic vision and philosophy of logistics. The focus of Leonid Borysovykh's scientific interests has always been logistic processes and phenomena, logistic systems and logistic objects, having studied which, he wrote new books, solved scientific problems, introduced research projects and strove to transfer knowledge to others. He did all this successfully, therefore he received

international recognition of the scientific community and the respect of business representatives. Let's try to focus on the most important Leonid Mirotim's achievements and scientific results.

Leonid Mirotim began to create a scientific school in the field of logistics, and in particular transport logistics, supply chain management and logistics management in the late 80s of the previous century. In 1993 he organized the Transport Management Department, which was firstly transformed into the Management and Logistics Department, and then into the Management Department. Leonid Borysovykh was in charge of this department until 2013. It was in those years that scientists, post-graduate students and applicants for scientific degrees from post-Soviet countries gathered at the site of the Moscow Automobile and Road Construction State Technical University and

held heated discussions about what logistics studies, its object and subject of research. Created in 1997 under the leadership of L.B. Mirotin The Logistics Coordinating Council (LCC) became the first organization in the post-Soviet space engaged in the development of logistics methodology, researches in this area, the development and implementation of business education programs, and the preparation of textbooks. The LCC establishment took place at a time when in the post-Soviet space few people had any idea what logistics was and there was a

high need for the formation of a methodological base and the dissemination of knowledge. Therefore, the LCC activities were very diverse - the scientific conferences and business forums organization, the preparation of educational programs and the development of business education, consulting activities and the implementation of logistics projects, educational work and the popularization of logistics as an effective tool for business in competitive environment. Naturally, all this gave good scientific results.



Photo 1. Delegation of the NAU Logistics Department at a scientific conference in Moscow Automobile and Road Construction State Technical University (2005).

In the period from 2002 to 2010, under the guidance and co-authorship of Leonid Mirotin the following textbooks were published: "Logistics", "Logistics for Entrepreneur", "Efficient Logistics", "The Basics of Logistics", "Transport and Warehouse Complexes", "Transport Logistics", "Logistics in Road Transport", "Freight Flows

Management in Transport and Logistics Systems", "Logistic Administration", "Introduction to Commercial Logistics", "Engineering Logistics", "Logistics Management Efficiency", "Car Service Management", "System Analysis in Logistics", "Logistics, Technology, Design of Warehouses, Transport Hubs and Terminals",

"Social and Technical Systems Management", "Marketing in Transport", "Integrated Logistic", "Transport and Loading-Unloading complexes", "ABC of Logistics Management of Commodity Flows Business Processes", "Freight transport Efficiency Improving Based on Sustainable Logistic System of Modular Type for High-Speed Processing and Goods Delivery", "Logistic Management in Transport", "The Basic of Logistics Management", "The Effectiveness of Logistics Management", "System Analysis of Logistics Management", "Logistics of Passenger Transportation". Given the huge shortage of Russian-language literature on logistics, these publications quickly became bestsellers and were actively cited in various countries that emerged in the post-Soviet space. It was these books that became the basis for the development of various educational programs and scientific research in various areas of logistics.

The next decade of Leonid Mirotin's scientific activity was devoted to rethinking the philosophy of logistics from the point of

view of harmonizing the interests of participants in the goods supply chain on the basis of an integrated system approach. In the article "Evolutionary Patterns of Logistics", it is concluded that the basic concepts associated with supply chain management have been transformed into the understanding of the priority for logistics of the functions of managing consumer demand chains in the market. The logistic approach should be embodied through the social purpose of human activity. Then the plot of the logistics concept becomes the need to ensure the adequacy of logistics structures to the demand. The structure of the logistics system in the form of a supply chain is matching demand and targets through the influence on the level of income and costs. The degree of the need for logistics depends on the level of people's socialization in society (understanding of the commensurability of costs and results of labor), the nature of the acting productive forces, technologies, social and legal situation and market relations in the country.



Photo 2. Leonid Mirotin speaks at the conference "Problems of Professional Logistics Personnel Training" in National Aviation University (2006)

In scientific publications of recent years, Leonid Mirotin emphasized the importance of an engineering approach in logistics. Engineering education and enjoyable manufacturing practice at many transport enterprises allowed him to lay the basic principles of engineering logistics and training of engineering personnel for logistics. The book "Engineering Logistics: Logistics-Oriented Product Life Cycle Management" contains a fundamentally new look at the organization of high-tech production and allows to learn the mechanism of logistic support for engineering solutions. The 4-volume monograph "Innovative Processes of Logistics Management in Intelligent Transport

Systems" developed to the ideas of innovativeness of logistics and logistics management, substantiated the need for the formation of industry-specific intelligent transport systems, as well as the development of multimodal cargo delivery technologies. Recommendations for the creation of corporate logistics centers, international transport management systems within transport corridors and transportation of small shipments in containers, a multimodal transport system for oil supplies in the region, grain export supplies, accelerated multimodal transportation, high-speed cargo handling, etc., are represent practical interest.



Photo 3. Luminaries of logistics science - Doctor of Economics, prof. Lukinsky V.S., Doctor of Technical Sciences, prof. Mirotin L.B., Doctor of Economics, prof. Protsenko O.D. in NAU (2006)

Mirotin Leonid Borysovyh is not only a scientist, researcher, but also an active public figure. He was one of the founders of the Scientific and Educational Center for Innovative Technologies in Logistics in

Moscow Automobile and Road Construction State Technical University. For many years, he has chaired the National Council for Supply Chains and served on the UNISCAN board for barcode implementation, RFID and

biometrics. Under the leadership of Leonid Mirotin were carried out a lot of projects, such as major scientific works as a strategy for the development of transport, a strategy for the fleet of specialized vehicles formation, a strategy for creating a logistics center at the stage of construction of facilities for the Sochi Olympics, a strategy for the formation of high-speed deliveries of cargo at Vnukovo airport

and many others. He led the projects for the logistics of the Olympic Games in Sochi at the stage of organizing the construction of sports and other facilities and organizing traffic in this enclave; creation of a powerful trading network in Moscow and the European part of Russia; effective functioning of the transport corridor of the East Siberian Railway and many others.



Photo 4. Long live Logistics - at a conference at the Kharkiv Academy of Municipal Economy (2006)

The geography of work and scientific activity of Leonid Mirotin is also impressive: from Cuba to Vietnam. He also repeatedly took part in scientific and practical conferences in Ukraine, namely, at the National Aviation University, National Transport University, National University "Lviv Polytechnic", Kharkiv Academy of Municipal Economy, Donetsk Academy of Automobile Transport, etc. He always made interesting reports, got into scientific discussions and subtly provoked the interlocutors to scientific research and their own reflections.

The editorial board of the journal "Intellectualization of Logistics and Supply Chain Management" sincerely congratulates Leonid Borysovykh on his 85th birthday. We wish you creative longevity and new scientific achievements. We are sure that your new book "Non-optimistic Notes of a Logistician", which includes both an autobiography and a professional vision of logistics, will find its loyal readers and give new food for scientific creativity of young scientists.

Scientific publication

**INTELLECTUALIZATION OF LOGISTICS AND SUPPLY CHAIN
MANAGEMENT**

The electronic scientifically and practical journal

№ 2 (2020)
July 2020

ISSN 2708-3195

DOI: <https://doi.org/10.46783/smart-scm/2020-2>



This work is licensed under a Creative Commons Attribution 4.0 International License