Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
X International Scientific Siberian Transport Forum

The evolution of the logistics ecosystem in the context of COVID-19

Oksana Pokrovskaya, Roman Fedorenko, Aleksandra Musatkina

Abstract

The study is devoted to the evolution of logistics ecosystems, the study of trends and drivers of their development, the systematization of the logistics ecosystems’ functional types and typical stages of their evolution. A review of scientific literature showed that the theoretical foundations of the logistics ecosystems development had not been sufficiently developed. Perhaps this is due to the relative youth of the "ecosystem" term, which has not been widely used until recently. The purpose of the study is to develop a holistic integrated approach to the study of the logistics ecosystems development stages. Methods of synergetics, logistics, terminalistics, regional economics, systems approach, transport geography were used. The development of terminal and warehouse infrastructure as the basic link of any logistics ecosystem should not only be linked to the strategic development of the national transport system, but also be maximally balanced with the trends prevailing in the world market and changing the consumer demands. The transformation of a business model into a business ecosystem allows ensuring the necessary and sufficient level of responsiveness to changes. A new approach to study the evolution of logistics ecosystems is needed, which is accelerating and often passes several development levels at once. A functional-logistic approach to the logistic ecosystems’ evolution is proposed, which makes it possible to comprehensively assess the completeness of the functionality and the logistic ecosystems’ development degree. The results obtained can be useful in substantiating the staged logistics ecosystems’ development of any level and their strategic management.

© 2022 The Authors. Published by ELSEVIER B.V.

This is an open access article under the CC BY-NC-ND license (https://creativecommons.org/licenses/by-nc-nd/4.0)

Peer-review under responsibility of the scientific committee of the X International Scientific Siberian Transport Forum

Keywords: COVID-19, transport and logistics market, evolution, logistics ecosystem, functional and logistics approach, logistics facility.;
1. Introduction

The COVID-19 pandemic has changed the businesses game laws. But the main thing remained unchanged - the
strongest wins the competition. The winner is the company that has managed to respond to rapid changes and adapt to
them, to provide a high-quality product or service in the face of powerful external factors. The world is becoming
more global, and information, goods and services are becoming more accessible. Logistics providers and their
electronic platforms are evolving from a "bulletin board" into the technology ecosystem giants, increasingly defining
the laws of the game in the market.

In the era of such accelerating and global changes, the transport and logistics market has transformed and acquired
new features. The modern market is divided not only by individual players, but by logistics ecosystems that have the
key property of success - a quick response to changing trends and a high degree of readiness for the new market
conditions. Business models based on the ecosystem approach have acquired particular interest in the transport and
logistics market, as in any other. The ecosystem approach makes it possible to develop tools for growth, differentiation
against the background of competitors and the search for targeted strategic tracks in a crisis.

A complex self-organizing system, which includes interconnected and interacting elements of different complexity
and internal architecture, which, under the external and internal factors’ influence, are transformed into the systems of
a new order and form a spatial-temporal structure that goes through several evolutionary stages in its development will
be considered as Logistics ecosystem.

In the digital economy 4.0, such ecosystems are based on a multi-stakeholder digital platform with an information
technology infrastructure and openness to partners. The connection between its elements lies in a mutually beneficial
work format for all participants based on the individual services’ transformation into slots and integrated customer
service complexes of the full cycle, that is, the logistics business evolves into ecosystems, becoming a "value asset" -
the basis for further own growth and development of other products within the ecosystem. At the same time, the main
advantage is that the failure of one or more elements in the delivery process does not mean stopping the entire logistics
chain.

Manufacturers, retailers (retail), construction and investment companies that own terminal facilities (development),
customers who order logistics services, forwarders, carriers, rolling stock operators, agents and logistics intermediaries
are the part of the logistics ecosystem, which unites the resources of all participants in the supply chain.

From a practical point of view, the global business has already appreciated the success of the ecosystem approach.
For example, according to statistics, after the creation of an integrated ecosystem of transport corridors of the Eurasian
Economic Union (EAEU) it is expected that the transport component in the cost of final products will decrease from
the current 20% to 12-15%. For example, the transportation of goods by rail along the route People's Republic of China
– EAEU – The European Union should be shortened up to 11 hours.

The new models and market participants, changing customer expectations, scalability of business models and the
role of asset ownership have determined the nature of future logistics ecosystems and their research directions. A
review of the scientific literature has shown that from a theoretical point of view, it mainly analyzes the new business
models and their implications for the transport ecosystem, which can provide more efficient, consumer-oriented and
sustainable transport provision (Merkert et al, 2020). The interest of the researchers around the world is attracted by
various forms of new business organization, including those based on deep collaboration of organizations with each
other. The business ecosystem was announced by J. F. Moore in 1993 (Moore, 1993). Ecosystems as a paradigm for
organizing complex cooperation are “dynamic developing communities, consisting of players from different sectors,
who jointly develop competencies around innovation, with which they work in a cooperative and competitive logic”
(Moore, 2006). Then the work (Adner et al, 2013) appeared, which gave rise to a real research "boom" and significantly
expanded and enriched the concept of J. F. Moore. For the logistics ecosystem, as indicated, for example, in
(Leviäkangas et al, 2020), a metamodel is valid, consisting of four elements: end-user value (value proposition to the
end-user), business value (shareholder value), collaboration value (business value for the supply chain) and social
value (creating value in the supply chain and controlling negative externalities) (Leviäkangas et al, 2020). The
ecosystem values in blockchain supply chain management are discussed in (Azzi et al, 2019), the ecosystem definitions
in the aspect of urban logistics were studied in (Lagorio et al, 2017), port ecosystems were considered in (García-
Onetti et al, 2021), digital industrial ecosystems were studied in (Ivanov et al, 2020; Bakhtadze et al, 2020).
There is interest in the relationship between business models, value chains and business ecosystems for the new and information-intensive transport system services. The issues of the origin, formation and subsequent transformation of logistics ecosystems of any level are fundamental in economic analysis (Gulyi, 2020 – Kazanskaya et al, 2020). For example, these are the calculations of the parameters of vehicles (Ivanov et al, 2013 – Maznev et al, 2020) and infrastructure (Kosenko et al, 2018 - Akimov, 2020), management of logistics operations (Kornienko et al, 2018 – Kornienko et al, 2020), the choice of multimodal technology and the interaction organization in the hubs (Miloslavskaya et al, 2019 - Bubnova et al, 2018). For more developed ecosystems, this is global positioning and connection both to cross-border supply chains, transport corridors, and to large hubs-gateways. J.-P. Rodrigue (Rodrique, 2017) (port logistics ecosystems), A. Rushton (Rushton et al, 2014) (logistics infrastructure), D. Middendorf (Middendorf, 1998), L.C. Nguyen (Nguyen et al, 2017) and A. Musso (Musso, 2010) (transport hubs).

A review of the scientific literature has shown that the theoretical foundations of the logistics ecosystems development have not been sufficiently developed. Perhaps this is due to the relative youth of the term "ecosystem", which until recently has not been widely used. The high scientific and practical relevance of studying the logistics ecosystems evolution is due to the fact that the whole range of solutions to improve its work depends on the logistics ecosystem development stage, both in terms of the logistics functionality development, and in terms of its own spatial, technological and organizational development. In this regard, the purpose of the study is to develop a holistic integrated approach to the study of the stages of logistics ecosystems development. Thus, the relevance of the study is dictated by the current trends in the logistics development in the world market.

2. Research methodology

The research was carried out using the methods and tools of synergy, logistics, transport geography, marketing analysis, regional economics, system and cluster approach. The study used statistical and analytical data of open Internet resources, as well as terminalistics - logistics of transport hubs and terminals (Pokrovskaya, 2018 – Sokolov et al, 2019).

This study seeks to develop a holistic and comprehensive functional logistic approach to the study of the logistics ecosystems evolution, taking into account the trends of digitalization, globalization, logistics versatility and customer focus. This article expands the theoretical knowledge about logistics ecosystems with the help of a new, functional and logistic approach both to the study of the stages of the transport and logistics infrastructure evolution, and to the complex ecosystems’ evolution typical paths systematization as a whole. The implementation of the concept of building a global logistics ecosystem should increase the carrying capacity of international transport corridors, its competitiveness and commercial attractiveness. In particular, this is achieved through the rational development of terminal and warehouse infrastructure serving freight transit along transport corridors. The development of terminal and warehouse infrastructure as the basic link of any logistics ecosystem should not only be linked to the strategic development of the national transport system, but also be maximally balanced with the trends prevailing in the world market and changing consumer demands. The transformation of a business model into a business ecosystem allows to provide the necessary and sufficient level of flexibility, responsiveness to changes and integration of solutions.

3. Results

3.1. Drivers and trends in the logistics ecosystem evolution in the conditions of COVID-19

Basic trend, observed in the transport and logistics market since the beginning of the pandemic is rapid development of e-commerce. It has become a driver of growth in freight traffic and the development of digital technologies in the logistics ecosystems’ construction. It became obvious that it is vital for companies that own terminal, warehouse and other logistics facilities to develop such strategic solutions in order to remain in demand among the “new consumer”, including in the emerging post-pandemic conditions.

Another significant trend is the activation of the terminal and warehouse segment of the business in terms of servicing transit and foreign economic cargo flows, due to the above "boom" of e-commerce. The emergence of a huge number of logistics facilities for servicing transit, loading and unloading and transshipment of export-import goods is
associated with the desire of companies participating in the transport and logistics market to maintain the stability of their own business models and develop anti-crisis mechanisms for obtaining profitable orders.

the transport and logistics market. Logistics companies around the world have come to the conclusion that maintaining a stable position in the market is impossible without transforming not only the tools (the use of electronic transactions and digital signatures), but also the business model itself. The format of building a business focuses on the ecosystems’ architecture that has synergistic and multiplicative efficiency to the extent sufficient for the survival of many companies in a crisis. In such conditions, it is very important to determine not only the specifics of the development level achieved by companies, but also to make a decision on the choice of a track for further evolution. Based on this, the ecosystem approach has become not only an anti-crisis tool, but also the imperative of the times.

Evolution drivers’ logistics ecosystems, as shown by the trends and conditions’ analysis in the transport and logistics market in the context of COVID-19, can be listed as follows:

1) growing demand for unique client solutions, which should be as flexible and personalized as possible in the struggle for the client. Such systems are the future issue, but under the condition of free integration with client.

2) aggravation of both global competition and competition in local markets – led to the actualization of the problems of developing an anti-crisis strategy, including the issues of rational step-by-step development of transport and logistics systems, taking into account market trends and development drivers.

3) active use of platform solutions – digital platform logistics services provide new competitive advantages, reduce risks and increase control over business processes. Such platforms give a possibility to solve the key business problems from anywhere, manage logistics budgets, tenders, tariffs, delivery times and volumes.

4) the desire of all participants in the transport and logistics market to minimize risks – during the pandemic, the need to expand the pool of transport suppliers, launch the new directions remains the same, while the choice of reliable partners is limited. There is a transformation of the business links’ architecture, they become more flexible, long, complex, integrated into the internal processes of many participants.

3.2. A New Approach to Researching the Logistic Ecosystems Evolution

Let us characterize the functional-logistic approach to the evolution of logistics ecosystems proposed in this study.

The logistics ecosystem evolution is consequent by the logistic ecosystem in the course of its functioning a sequence of changes in the state parameters, which together ensure its transformation into an ecosystem of a new order and of a qualitatively different type (according to Fig.1). Fig.1 shows the hierarchy of logistic ecosystems in the direction of their evolution).

![Fig. 1. Logistics ecosystems evolution (from less to more advanced level). Compiled by the author.](image-url)
Concept development stages are the key factors to the new approach. The approach is based on the logistics ecosystem development stages’ classification, taking into account the range and complexity of the logistics service being implemented. Stage of development (evolution) – is a period of time during which the logistics ecosystem has moved to a different, qualitative level in the process of evolution of its role in the logistics system of cargo delivery, taking into account the assortment, orientation and complexity of the logistics functions performed when interacting with the external environment of the transport and logistics market. Each stage is characterized by a number of parameters achieved at a given time determining the type of logistics ecosystem, taking into account its functional, spatial, technological, technical and organizational development (Fig. 1).

Functional and logistic approach – it is an independent set of general interdisciplinary methods and principles, the basis of which is a comprehensive consideration of logistic ecosystems, represented by a geographically (spatially) and economically concentrated set of logistic objects and transport sections, as well as the participants in the transportation process interacting in them when implementing an end-to-end integrated transport and logistics service in management transportation processes. The applied nature of the approach is to ensure the "seamless" integration of logistics facilities, chains and systems to higher-level logistics ecosystems, as well as rational operation and comprehensive study of the development of existing logistics ecosystems of various types.

The most indicative, in our opinion, is the evolution of transport hubs as a type of logistic ecosystems, therefore, we will consider the concept of the functional-logistic approach using their example. In general, the development of any logistics ecosystem goes through three evolution stages: 1) a hub, at which the conditions for the additional services’ provision and transition to a new stage are formed with the development of intra-node interaction; 2) a docking point for transport modes, where interaction becomes inter-node, and the service allows servicing complex cargo delivery systems; 3) a multimodal transport and logistics facility, which provides a comprehensive end-to-end service for clientele, rolling stock, cargo ("seamless technology").

This variant of the logistics ecosystems evolution is characteristic of historical development, based on the existing infrastructure base. In particular, it is proposed to adapt the model for the development of port infrastructure in the "hinterland" format J.-P. Rodrigue (Rodrigue, 2017) and T. Notteboom (Nguyen et al, 2017) for the railway transport logistics ecosystems. Based on the operation of logistic ecosystems of various types in the European Union, the USA and Russia, another adapted model of the railway junctions’ evolution is proposed. Thus, the development of a railway junction occurs in 4 stages, taking into account the transformation of internal processes: 1) the isolated existence of individual elements (objects of the terminal and logistics infrastructure); 2) concentration (enlargement, concentration and integration of elements into a node (logistics hub); 3) building up infrastructure (connecting auxiliary elements, building up expanded infrastructure support); 4) regionalization followed by reaching a new level (“connecting” to local and global transport and logistics systems) (compiled by the author taking into account (Rodrigue, 2017 - Musso, 2010)). It can be concluded that the functional-logistic approach can be considered as an alternative theoretical model of the typical logistic ecosystem’s evolution, on the one hand, and as an applied tool for assessing and developing options for the logistics ecosystem development, on the other hand.

4. Results analysis. Applying an approach to real logistics ecosystems

The first example of the described theoretical model of evolution can be the experience of creating and developing the logistics ecosystem Venlo Trade Port (Venlo, the Netherlands) (Venlo, Trade Port Noord). At the 1st stage, 1989, the territory of Venlo Trade Port was 35 ha, this is the stage of the genesis of interconnections and fragmented existence of the logistics ecosystem elements. At the second stage, which lasted from 1991 (plus 300 hectares of territory) to 1996 (more than 350 hectares of the occupied territory), the elements were concentrated into the core, stable functional and technological relationships were established, and the internal architecture of the ecosystem was determined. At the third stage, the terminal and warehouse infrastructure had been built up; by 2005, the total area of the territory reached more than 1 000 ha, production, logistics and terminal capacities had been formed to enter the most developed stage of evolution, 4th. At the 4th stage, which continues to the present, there is a deepening of logistics connections, regionalization and the formation of a higher-order logistics ecosystem - a logistics zone (according to Fig. 1).

The development of the logistics center "Quadranite Europa Freight Village" (Verona, Italy) (Interporto Quadrante Europa) can be considered as a second example, the evolution of the logistics ecosystem along the service orientation track: internal environment =>>> external environment =>>> a client where the driving force behind evolution is the
complication of the service package: Stage 1 - in 1948 CONSORCIO ZAI - Verona Agrarian-Industrial Consortium was created. The development of an area of about 250 hectares, the connection of rail and road communications, a key resident was involved - the Italian distributor of Volkswagen, Audi, Skoda, Seat - AUTOGERMA. Own territory - 150 hectares with warehouse and office premises, with an exhibition hall, a training center and a distribution complex with an area of 60 thousand square meters; Stage 2 - creation of a logistics center "Quadrante Europa Freight Village" on an area of 350 hectares, as the next stage in the two industrial zones’ development, with the parallel construction of a complex for storing perishable goods with an area of 130 hectares; and the innovation zone MARANGONA (science and technology park) with an area of 100 hectares; Stage 3 - formation of an agro-industrial zone (ZAI UNO) with an area of 600 hectares, 600 resident companies; industrial zone (ZAI DUE), with an area of 100 hectares, 120 resident companies; Stage 4 - (achieved to date): Quadrante Europa Freight Village is an integrated logistics service center with a multimodal terminal. A "park of logistics activities" was created, where more than 100 companies and 1800 employees work.

In the third case, with new construction, the evolutionary development of the logistics ecosystem "from scratch" becomes somewhat different. In Fig. 2, we compare the model proposed by the author and the Rodrigue-Notteboom model on the logistics ecosystem evolution example of the port of Ust-Luga (Leningrad region) (Ust-Luga Multimodal Complex).

![Fig. 2. An example of the port logistics ecosystem evolution of the port of Ust-Luga, Russia. Compiled by the author based on data from the official website (Ust-Luga Multimodal Complex).](image)

For different objects, obviously, the development stages can be different (we are talking about the duration of each stage), but on the whole, evolution is typical. Using the example of a transport hub in the port of Ust-Luga, the following stages of the completed functional and logistic development can be distinguished:

1 – construction of individual elements (preparation of the quay wall, construction of a railway station, commissioning of the first 4 terminals under the project);

2 – enlargement of the core - the logistics framework of the ecosystem (commissioning of 4 more groups of terminals, specialized for various cargoes);

3 – connection of auxiliary elements (creation of an industrial and industrial park, housing construction, integrated development of the port area);

4 – regionalization, clustering (obtaining a multiplier effect, attracting resident companies, expanding the ecosystem orbit, active integration / hinterland absorption and / or comprehensive development of the adjacent territory, etc.).

This allows us to assert the practical applicability of the logistics ecosystems’ functional and logistic development concept for the ecosystems of different types, located at different points of deployment on the world map. This, in turn, testifies not only to the applied nature of the proposed model of the logistics ecosystems’ evolution, but also to the universality of the proposed approach.
5. Conclusions

The results of this study allow us to assess the logistics ecosystem evolution stage and contribute to the development of effective modes of logistics ecosystems functioning in the context of the COVID-19 pandemic and its consequences. The significance of the research performed can be characterized as the scientific foundations’ formation of the logistic ecosystems’ staged development under the influence of external and internal factors. A functional-logistic approach to the evolution of logistic ecosystems has been developed, a theoretical model of a typical step-by-step evolution based on the author’s system of logistic ecosystems classification has been presented. Drivers and trends in the logistics ecosystems development have been noted. Universality and practical applicability of the proposed approach has been confirmed on the examples of really working ecosystems in different countries of the world.

This study shows that a new approach to study the evolution of logistics ecosystems is needed, which accelerates and often passes several levels of development at once. In this study, a functional-logistic approach to the evolution of logistics ecosystems is proposed, which allows a comprehensive assessment of both the completeness of the functionality and the development degree of logistics chains built and controlled by the ecosystem.

According to the scientific literature review, a holistic integrated approach to the study of the stages of development and metamorphosis of logistic ecosystems has not received the necessary and sufficient reflection. Modern science and practice today are faced with the task of developing a more holistic approach to planning an alternative and assessing the achieved level of the ecosystem functional and logistic development.

As the analysis of the trends in the transport and logistics market in the post-Covid world has shown, one of the negative aspects affecting the new ecosystems’ emergence dynamics, for example, in Russia, is the uncertainty of small and medium-sized businesses in the long-term prospects of the national market. This is due to the lack of sufficient support from the state, and with the lack of sufficient tax breaks for startups, and with an insufficiently developed legal framework that provides a sense of reliability for those who are just starting to move in this direction. Creating a logistics ecosystem at the national level makes it possible to realize such advantages as an increase in the return on the infrastructure projects’ investment, an increase in the quality level and safety of seamless transport services, a decrease in the transshipment cost and storage of goods, as well as accelerated delivery of goods.

Obviously, the further development direction will be the digitalization of business as one of the main trends in the "post-Covid" world. According to a survey by the consulting company BCG, 83% of companies cite digitalization as one of their priorities, and two-thirds plan to increase investments in this area.

It can be assumed that the results obtained will be useful in substantiating the staged development of logistics ecosystems of any level, from the simplest cargo terminal to complex transport and logistics hubs, as well as in the strategic management of logistics ecosystems. More in-depth studies can be aimed at assessing the influence of factors and clarifying the national specifics of the logistics ecosystems development, searching for effective tools for establishing sustainable business structures and regional self-positioning of ecosystems in logistics, searching for the new formats for business development in logistics ecosystems, as well as developing effective strategic management tools sustainable and balanced development of national and global logistics ecosystems in general.

Acknowledgments

The reported study was funded by RFBR and FRLC according to the research project № 19-510-23001.
Creating a logistics ecosystem at the national level makes it possible to realize such advantages as an increase in the functional and logistic approach to planning an alternative and universal approach to the study of the stages of development of business ecosystems (Advances in Strategic Management), Emerald Books, Bingley. DOI: 10.1108/S0742-3322(2013)000030063. Akimov, S., 2020. Stress state of a roadbed reinforced with soil-concrete layer. Transportation Research Procedia Transport Forum – TransSiberia 2020 1116, 495-502, https://doi.org/10.1016/j.trpro.2021.02.100.

Bakhtadze, N., Suleykin, A., 2020. Industrial digital ecosystems: Predictive models and architecture development issues. Annual Reviews in Control. https://doi.org/10.1016/j.arcontrol.2020.11.001 (accessed 11 June 2021).

Bessonenko, S., Kornienko, K., Tanaino, I., 2018. Influence of opposite elevation on the occupancy level of the tracks of sorting park. MATEC Web of Conferences 239, 03002, https://doi.org/10.1051/matecconf/201823903002.

Bubnova, G.V., Efimova, O.V., Karapetyants, I.V., Kurenkov, P.V., 2018. Digitalization of intellectualization of logistics of intermodal and multimodal transport. MATEC Web of Conferences, 0203. DOI: 10.1051/ matecconf/20182360213.

Bubnova, G.V., Efimova, O.V., Karapetyants, I.V., Kurenkov, P.V., 2018. Digitalization of intellectualization of logistics of intermodal and multimodal transport. MATEC Web of Conferences, 0203. DOI: 10.1051/ matecconf/20182360213.

Garcia-Onetti, J., Scherer, M.E.G., Asmus, M.L., Sanabria, J.G., Barragán, J.M., 2021. Integrating ecosystem services for the socio-ecological management of ports. Ocean & Coastal Management 206, 105583. https://doi.org/10.1016/j.ocecoaman.2021.105583.

Azri, R., Chamoun, R.K., Sokhn, M., 2019. The power of a blockchain-based supply chain. Computers & Industrial Engineering 135, 582-592. https://doi.org/10.1016/j.cie.2019.06.042.

Kornienko K., Bessonenko S., 2018. Effect of the sorting track profile change on its occupancy quality at train humping. MATEC Web of Conferences 216, 02012, https://doi.org/10.1051/matecconf/20182160212.

Kornienko, K., Tanaino, I., Bessonenko, S., 2020. Using the Coefficient of Concavity in the Analysis of the Quality of Filling the Tracks of the Hump Yard: Advances in Intelligent Systems and Computing 1115, 655–662, https://doi.org/10.1007/978-3-030-37916-2_63.

Kosenko, S., Akimov, S., 2018. Design of track structure for corridors of heavy-train traffic. MATEC Web of Conferences 239, 05005, 1–12, https://doi.org/10.1051/matecconf/201823905005.

Kurenkov, P., Pokrovskaya, O., Anastasov, M., Sokolov, M., Bochkov, A., 2019. Study of the current state of the transport infrastructure of road and rail transport of the Russian Federation. IOP Conference Series: Materials Science and Engineering. International Scientific Conference “Construction and Architecture: Theory and Practice of Innovative Development”. Kislovodsk, Russian Federation 698, https://doi.org/10.1088/1757-899X/698/6/066064.

Lagorio, A., Pinto, R., Golini, R., 2017. Urban Logistics Ecosystem: a system of system framework for stakeholders in urban freight transport projects. IFAC-PapersOnLine 50(1), 7284-7289. https://doi.org/10.1016/j.ifacol.2017.08.1402.

Leviäkangas, P., Öörni, R., 2020. From business models to value networks and business ecosystems – What does it mean for the economics and governance of the transport system? Utilities Policy 64, 101046. https://doi.org/10.1016/j.jup.2020.101046.

Maznev, A.S., Boronenko, Y.P., Vorobiev, A.A. Kiselev A.A., 2020. Multimodal Semiconductor Converter for Direct Current Electric Trains: Structure and Control Principles Russian Electrical Engineering 91, 98–103, DOI. 10.3103/S1068371220020066.

Merkert, R., Wong Y.Z., 2020. Emerging business models and implications for the transport ecosystem. Research in Transportation Economics 83, 100911. https://doi.org/10.1016/j.retrec.2020.100911 1

Middendorf, D., 1998. Intermodal Terminals Database: Concepts, Design, Implementation, and Maintenance. Bureau of Transportation Statistics U.S. Department of Transportation, Washington DC.

Miloslavskaya, S., Panychev, A., Myskina, A., Kurenkov, P., Rudakova, E., 2019. Organization of export transportation of goods from Russia to China. IOP Conference Series: Materials Science and Engineering 698(6), 066065, DOI: 10.1088/1757-899X/698/6/066065.

Moore, J.F., 1993. Predators and Prey: A New Ecology of Competition, Harvard Business Review 71(3), 75–86. https://www.researchgate.net/publication/13172133_Predators_and_Prey_A_New_Ecology_of_Competition (accessed 11 June 2021).

Moore, J.F., 2006. Business ecosystems and the view from the firm. The Antitrust Bulletin/Fall 51(1), 12-19. DOI: 10.1177/0003603X0605100103

Musso, A., 2010. Progetto di Terminali ed Impianti di Trasporto, Chapter 2. Sapienza Università di Roma, Rome.

Nguyen, L.C., Notteboom, T., 2017. World Review of Intermodal Transportation Research 6(3), 229-250.
Creating a logistics ecosystem at the national level makes it possible to realize such advantages as an increase in the efficiency of logistics processes, the development of new formats for business development in logistics ecosystems, as well as developing effective strategic management to establish sustainable business structures and regional self-positioning of ecosystems in logistics, searching for the optimal location of logistics centers.

Acknowledgments

As the analysis of the trends in the transport and logistics market in the post-Covid world has shown, one of the main problems is the lack of sufficient support from the state, and with the lack of sufficient tax breaks for startups, and with an insufficiently developed educational and research infrastructure. Modern science and practice of logistics ecosystems is proposed, which allows a comprehensive assessment of both the completeness of the ecosystem and the potential areas for improvement.

The use of the system of logistic ecosystems classification based on the author's system of logistic ecosystems classification has been presented. Drivers and trends in the logistics market, as well as the metamorphosis of logistic ecosystems has not received the necessary and sufficient reflection. Modern science and practice of logistics ecosystems is proposed, which allows a comprehensive assessment of both the completeness of the ecosystem and the potential areas for improvement.

References

Adner, R., Oxley, J.E., Silverman, B.S., 2013. Introduction: Collaboration and competition in business ecosystems. Collaboration and competition drivers and trends in the logistics market, as well as the metamorphosis of logistic ecosystems has not received the necessary and sufficient reflection. Modern science and practice of logistics ecosystems is proposed, which allows a comprehensive assessment of both the completeness of the ecosystem and the potential areas for improvement.

Azzi, R., Chamoun, R.K., Sokhn, M., 2019. The power of a blockchain -based supply chain. Computers & Industrial Engineering 135, 582 -592.

Bakhtadze, N., Suleykin, A., 2020. Industrial digital ecosystems: Predictive models and architecture development issues . Annual Reviews in Construction and Architecture: Theory and Practice of Innovative Development. Kislovodsk, Russian Federation 698, DOI: 10.1007/978-3-030-37919-3_114.

Bubnova, G.V., Efimova, I.V., Kurenkov, P.V., 2018. Digitalization of intellectualization of logistics of intermodal and rail transport of the Russian Federation. IOP Conference Series: Materials Science and Engineering. International Scientific Conference Conferences 216, 02014, DOI: 10.1051/matecconf/201821602014.

Merkert, R., Wong Y.Z., 2020. Emerging business models and implications for the transport ecosystem. Research in Transportation Economics 83, 171-180.

Miloslavskaya, S., Panychev, A., Myskina, A., Kurenkov, P., Rudakova, E., 2019. Organization of export transportation of goods from Russia to Ust-Luga Multimodal Complex. https://ust-luga-mmc.ru/ (accessed 11 June 2021).

Sokolov, Y., Efimova, O., Lavrov, I., Pokrovskaya, O., 2019. Investigation of the market potential of transport and logistics services in the 1520 space. IOP Conference Series: Earth and Environmental Science 403(1), 012213 DOI: 10.1088/1755-1315/403/1/012213.

Venlo, Trade Port Noord. https://www.venlo.nl/venlo-trade-port-noord-1 (accessed 11 June 2021).

Rushton, A., Croucher, Ph., Baker, P., 2014. The Handbook of Logistics and Distribution Management. Kogan Page Publishers, London.

Sokolov, Y., Efimova, O., Lavrov, I., Pokrovskaya, O., 2019. Investigation of the market potential of transport and logistics services in the 1520 space. IOP Conference Series: Earth and Environmental Science 403(1), 012213 DOI: 10.1088/1755-1315/403/1/012213.

Ust-Luga Multimodal Complex. https://ust-luga-mmc.ru/ (accessed 11 June 2021).